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USE OF MUCK SOILS FOR THE PRODUCTION OF GENERAL FARM CROPS.[1]

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While peat or muck soils are particularly adapted to the intensive growing of vegetable crops, a very small percentage of peat can be cropped in vegetables. It must be borne in mind that there are in the United States some 15 million acres of swamp land consisting largely of peaty soils. In Michigan and Indiana alone there are over 3 million acres of swamp soils. According to the last U. S. Census, the total acreage of vegetables which might be grown on muck, including onions, celery, cabbage, lettuce, asparagus and mint, amounts to less than 300,000 acres, much of which is grown on soils other than peat. It is safe to say that if as much as 200,000 acres of these crops were put out on peat soil, the vegetable markets would be glutted. For this reason we must look to general farm crops if these valuable lands are to be cultivated.

It is the experience of competent observers that practically all crops which can be grown on other soils in the same locality can be grown on peat. The following general farm crops grown in Indiana are especially profitable on peat: pasture grass, hay, corn, and potatoes. Rye, wheat, oats, and buckwheat can be grown on muck, except in unfavorable seasons. With cultivated farm crops as with vegetables, there is no type of soil in Indiana which is more subject to climatic conditions than peat.

[1] Read at the Sixteenth Annual Convention of the American Peat Society.

Grass.

It is probable that the one crop which is the least subject to climatic variations, and which will yield a steady and profitable return each year, is hay or grass. In U. S. Department of Agriculture Farmers' Bulletin No. 761, hay is credited with a greater man labor income than any other crop grown on muck. At the same time it is credited with a small acre value. This would mean that hay or pasture grass would be profitable only on large farms and where there is a limited supply of labor. Few, if any, experiments have been reported upon the effect of fertilizer and lime with grass on peat, but in view of the fact that grass responds in a similar way to grain crops on mineral soils, there is no reason to believe that it would not be improved by the addition of fertilizers and lime on peat. On the Pinney-Purdue Experiment Field, which is on a peaty, sand soil, the addition of potash and phosphate increased the yield of mixed hay 800 pounds per acre without lime, and over 1,500 pounds per acre on limed land, increases which were fully as great as those obtained on corn and oats. Pastures and meadows on peat should be properly drained. Some grass lands on peat would be benefited by heavy rolling after drainage.

Corn.

Corn on peat land does very well in normal years. It produces more value per acre than grass, but it takes more labor and does not produce quite so great a value per man. Owing to the fact that frost is liable to hit muck late in the spring and early in the fall, early maturing varieties of corn should be used. Corn takes a large amount of potash, the element which is generally most deficient in Indiana muck. For this reason it pays to apply potash fertilizer in large amounts. On the Lake Bruce Experiment Field corn produced over 75 bushels per acre in 1921 with potash. All forms of potash are being tried on this field, both German salts and American potash salts. There has been no material difference between the two sources during 1920 and 1921, the American potash salts producing an average in-

crease of 26 bushels of corn per acre per year, and the German potash 24 bushels per acre per year. Both the quality as well as the quantity of corn was improved. Incidentally it might be of interest to say that Mr. R. H. Hardin of Henry county, Indiana, took first prize in the 5-acre corn contest in 1921 by raising 129.7 bushels of corn per acre, on muck soil.

Potatoes.

There were 3,600,000 acres of Irish potatoes grown in the United States according to the last census. It is easily possible to greatly increase the acreage of muck grown potatoes without glutting the market. There is probably no field crop grown in this section which will respond to fertilizer more profitably than potatoes, and which will do so well on peat. Most Indiana peat soils are deficient in potash. On peat soil in Tippecanoe County in 1911, unfertilized peat produced 135 bushels of potatoes per acre. Two hundred pounds muriate of potash alone gave a yield of 175 bushels per acre. The addition of acid phosphate and nitrogen gave little increase over the potash alone. Muriate of potash gave as good results as sulphate of potash with no essential difference in quality.

In 1912 in LaPorte County unfertilized potatoes on peat yielded 44 bushels per acre. Nitrogen and phosphate gave a yield of 38 bushels per acre. The addition of 200 pounds sulphate of potash increased the yield of 133 bushels per acre, while double the potash produced a yield of 150 bushels per acre.

In an average of five fertilizer experiments on peat soils with potatoes, using 1,000 pounds per acre of a 4-8-10 fertilizer the 4 per cent nitrogen increased the yield only one bushel per acre. The 8 per cent phosphoric acid increased the crop 19 bushels per acre, while the potash gave an average increase of 75 bushels per acre. Two hundred to 300 pounds of muriate of potash and 200 to 300 pounds 16 per cent acid phosphate are recommended as a potato fertilizer on the average Indiana muck soils. While sulphate of potash gives a slightly better qualtity potato than muriate of potash, the difference would hardly justify the increased expense.

Contrary to general opinion good quality potatoes can be grown on muck. The poor quality of ordinary muck grown potatoes is due to the fact that they are too often grown without fertilizer. If adequate amounts of the proper fertilizer are used, fine quality potatoes can be grown on muck soils in Indiana. According to Minnesota Bulletin No. 188, by Dr. F. J. Alway, potatoes are considered in Europe the very best crop for newly broken peat lands. In Austria and Sweden the highest quality potatoes are grown on peat. If there is a deficiency of mineral fertilizers, particularly potash, watery potatoes of poor quality are produced on muck.

In 1921 Mr. Stauffer of Akron, Indiana, produced 425 bushel of potatoes per acre on muck soil. The crop was properly fertilized with plenty of potash and the tubers were of the very highest quality. His yield of potatoes on muck in 1920 was over 300 bushels per acre and this year will run almost the same in spite of the extremely dry season. Onions were grown this year on the piece of muck which produced 425 bushels potatoes per acre in 1921, the yield being 900 bushels per acre. Additional fertilizer was of course used.

If the greatest success is obtained with potatoes, high grade selected seed must be used at a fairly heavy rate, and the tops must be sprayed at the proper times during the summer.

Wheat and Other Small Grain.

While small grain has not been grown very extensively on peat in Indiana, many farmers report big success. With all small grains on muck it is very important to supply plenty of minerals otherwise the crop will have weak straw and will lodge.

Peat and muck soils are undervalued by the average farmer and real estate dealer. It is an extremely difficult matter to get a real estate dealer to admit that any of his farms have peat or muck on them. He will say if he is pinned down: "Oh, a very small part is a little chaffy but it is not real muck." It is my opinion that many Indiana farms

would be vastly more profitable to farm if they did have a good sized field of real muck.

Muck soils are very rich in nitrogen and organic matter, the two soil ingredients which are the most difficult and expensive to keep up. Peat soil has a bad name because it takes somewhat more specialized knowledge and ability to handle it profitably. It can not be neglected nor mistreated if profitable crops are to be grown. Peat soils must be properly drained, not overdrained. Peat must be adequately fertilized generally with potash, and to a less degree with phosphate. About five per cent of Indiana muck soils are acid and need lime first, and then phosphate more than potash.

PEAT FUEL RESOURCES OF UNITED STATES.[1]

By C. C. Osborn.

Formerly in charge of peat investigations for the U. S. Geological Survey

Forms of Peat Fuel

Air-dried machine-made blocks, briquettes, powder, and gas are the principal forms of peat fuel. Much experimental work in making and using these products has been done in North America. In some instances it has been successful and in all encouraging. Good coke is also made from peat in Europe and there is no reason why it can not also be produced here. The greatest success has attended the manufacture of air-dried machine blocks. This product and the raw peat from which powdered fuel can be made are illustrated by the accompanying photographs.

Commercial Factors

The geologic, topographic, and physical and chemical features of peat have been discussed in the preceding edition of COMBUSTION. Before entering into the details of the production and utilization of each product brief discussion will be made of some of the broad practical factors that bear on the problem.

The location of the deposit is one of the prime considerations. Peat is so bulky that it can not be economically transported long distances, and the supply must therefore be located near the point of consumption. It must enjoy facilities for adequate transportation. Water transportation and short rail or truck hauls are the only means by which peat can be profitably handled. The most promising possibilities for peat fuel

[1] Reprinted from September and October, 1922 editions of Combustion. The first installment of this paper was printed in the October, 1922, Journal.

are presented by the deposits of Massachusetts, Connecticut New York, Minnesota, Wisconsin, and Michigan. Cheap drainage must be feasible in order to prepare the surface of the deposit for profitable fuel production. Peat is inflammable when dry and all buildings should be as nearly fireproof as possible. Unless a market exists or can be created for peat fuel near the deposit it has small chance for a successful future. It is essentially a local industry.

The Moisture Problem

The elimination of moisture is the fundamental problem of peat production and utilization. The affinity of peat for moisture is proverbial. In fact peat can not form unless the plant debris is covered or saturated with water. The peat in most deposits contains about 90 per cent of moisture, which is held both mechanically and chemically in the plant cells and intercellular spaces. In other words a short ton of typical raw peat consists of about 200 pounds of solid matter to 1,800 pounds of water. The reduction of this high content of moisture is the paramount necessity in the commercial utilization of peat. Many attempts have been made to remove the excess moisture by compression and other artificial processes but it resists the strongest pressure obtainable and, so far as known, the only economic method of materially reducing the moisture content is natural evaporation produced by the forces of the sun and the wind. The accompanying table shows the relation between the solid and liquid constituents of a typical ton of raw peat as its water content is progressively reduced from 90 to 10 per cent.

Artificial drying as a complete process of moisture elimination has not been successful because it requires the expenditure of more heat than can be obtained from the finished fuel. If waste heat could be obtained, however, the process might be practicable. Machine peat can readily be made by the air-drying process, gas is manufactured from relatively wet peat, and it is said that briquettes may be air-dried. Before peat can be used for ordinary fuel the moisture must

be reduced to below 30 per cent, and in case of powdered fuel considerably below this figure. Best results with pulverized peat are obtained at less than 10 per cent, but this would of course necessitate the completion of the drying by an artificial process. It is obvious that peat fuel must be prepared during the air-drying season, which in the United States usually begins in April or May and ends in September or October.

Machine Peat.

Machine peat is adapted for practically the same uses as bituminous coal. For industrial purposes good machine peat feul will be found equal in heating value to some grades of mine-run coal. This is particularly true for steam raising. Good peat because of its high oxygen and low ash contents

Air Dried Machine Peat.

will give a good account of itself in an industrial furnace. Combustion is complete and efficient, there is little unconsumed residue, and the boiler efficiency is high. Tests made in this country and abroad have been successful and millions of tons of machine peat are used annually for steam raising and industrial heat and power in Europe.

The most notable steam power plant utilizing peat exclusively as a fuel is that erected by the Siemens Electric Co.,

on the Wiesmoor in Germany. It is thus described by B. F. Haanel, of the Canada Department of Mines:

"This steam plant is of most modern design, consisting of specially designed steam generators, Zoelly steam turbines, and elaborate and well worked out conveying machinery for transporting peat from the sheds to the boilers. The fuel is fed to the boilers automatically, and it is claimed that very high boiler efficiencies were obtained, namely in the vicinity of 73.5 per cent. In dry weather a consumption of 2.4 kilograms (5.28 pounds) per k. w. hour has been obtained. In wet weather, however, the fuel consumption is 3 kilograms (6.6 pounds) and upwards per k. w. hour. The capacity of this power plant was in the neighborhood of 5,400 H P. when the writer visited it. It was said that with peat fuel containing 30 per cent of moisture and costing $1.25 per ton delivered to the plant, power could be more cheaply produced than with coal costing $3.50 per ton delivered to the plant."

No data are available concerning present producing costs in Europe, but during the war machine peat and hand cut peat sold for about 3.50 florins per cubic meter at the bog in Holland. At present the price is less than 2 florins.

There is no established price for peat fuel in the United States. Machinery capable of turning out 200 tons a day can be built for less than $100,000 and the cost of production will range from $1.50 to $3.00 depending upon the degree of efficiency. Operated at a maximum capacity this rate of production could be doubled. The process involves the hand turning and harvesting of the blocks. If this hand work could be eliminated production costs can be greatly reduced. Peat can be layed down for drying at a cost considerably less than 75 cents per ton.

Machine peat is also well adapted for domestic use, and for open grates it is ideal.

Powdered Peat

Peat in the form of fine powder, burned under a blast in a specially constructed burner, makes a very efficient fuel. The process of preparation is simple. The peat is excavated, gathered in a partially air-dried condition, dried further arti-

ficially, and then pulverized. Where waste heat is available for the artificial drying, or the moisture content has been thoroughly reduced by air-drying, the process seems feasible. The resulting powder is dark-colored, non-absorbent, and almost as heavy as powdered coal.

In firing peat powder no smoke is developed, because the supply of air can be adjusted so that combustion is complete. The powdered peat is blown with compressed air into the furnace, where by means of forced draft ignition is almost instantaneous, and instead of burning on the grate the peat is consumed like gas and gives a uniform fire throughout the combustion chamber.

The temperatures obtained and held by properly built peat powder burners are sufficient to melt glass, iron, steel, and other metals, and the use of peat fuel of this type for

Stock Pile of Air Dried Peat Ready For Pulverizing

burning brick, lime, and cement should be widely extended in regions where these industries are conducted and peat is abundant.

A successful test was conducted a few years ago in the use of powedered peat for locomotive purposes in Sweden and as a result it is being used to a considerable extent. The following is a description of the test:

"Comparative tests were made with two locomotives of the same type, one being fired with peat averaging 7,920

British thermal units in calorific value and the other with coal capable of generating 13,030 British thermal units. A hopper was mounted on the tender to hold the peat, from which it was blown through a pipe into the fire box. It is said that the temperature of the fire box on the peat-burning locomotive averaged 1.670 degrees C. and that the efficiency of the boiler was 73 per cent, whereas on the coal-burning engine the temperature of the fire-box averaged 1,510 degrees C. and the efficiency of the boiler was 68.8 per cent. The test proved conclusively that powdered peat could be successfully used as locomotive fuel."

E. A. Beals, of Hartford, Conn., and the Hennepin Atomized Fuel Co., of Minneapolis, Minn., have made experiments with powdered peat in this country. The former attempted to generate electricity for the N. Y., N. H. & H. R. R. Co. at its Burrville, Conn., station, but the project was abandoned. Last winter the latter company attemped to heat the Phoenix and other buildings of Minneapolis with powdered peat. The use of the peat was successful enough, but it is understood that the cost of production was high, and the company has been reorganized and will attempt to market powdered peat in Minnesota. The high cost of production may perhaps be attributed to insufficient moisture elimination by air-drying prior to pulverizing.

Peat Briquettes

Peat briquettes are usually made from peat which has been air-dried to a moisture content of 40 per cent. After the peat has been macerated and powdered, the moisture is further reduced to about 15 per cent by artificial drying. A binder is then mixed with the peat and the mixture is compressed into cylindrical or prismatic shape by means of a piston subjected to a pressure of from 18,000 to 30,000 pounds per square inch. Although there is little more heating value per pound in peat briquettes than in machine peat, the briquettes are cleaner, more compact, greater in heating value per unit volume, and generally more attractive in appearance than machine peat. These advantages, however, are more than offset by the high cost of production. Artificial drying

requires so much heat in comparison with that obtainable from peat briquettes prepared in this manner, and the cost of binders and compressing is so great, that this process is at present of doubtful commercial value in the United States.

A method has recently been proposed by an American company that offers more promising possibilities than that above described. It consists of passing macerated peat containing about 35 per cent of moisture directly into a roller press, and subsequently air drying the briquettes. No binder is used except the natural hydrocellulose of the peat. Good briquettes are said to be obtained and drying marked shrinkage and hardening occurred. Only minute cracks developed and the result was said to be a fuel that would stand dropping from considerable heights without breaking. The Peat Products Co., of Eaton Rapids, Mich., is attempting to commercialize the process, which has been patented by the General Briquetting Co., of New York City.

Peat Coke

Peat charcoal was made in Europe for hundreds of years by piling cut peat in dome-shaped heaps, covering it with soil, and burning the peat with a restricted supply of oxygen. This process is little used now, and peat charcoal has been displaced by peat coke, which is manufactured by the Ziegler process. According to this method the coke is produced by heating machine peat blocks in specially designed retorts. Good peat coke is equal in quality to the best grades of charcoal produced from wood. If made from blocks of well-macerated, thoroughly decomposed peat that contains little ash, peat coke is compact and hard and should be able to compete with coke manufactured from coal. Peat coke is extensively used in Europe, but in the United States, though it could probably be prepared for about $4.00 to $6.00 per ton, this material has never been commercially produced. There are large deposits of peat suitable for the production of coke within a few miles of the iron-mining district of Minnesota, and it seems that the practicability of locating peat coke plants in this region should receive thoughtful consideration.

Peat Gas.

There are two kinds of by-product gas producing plants that use peat—the Mond and the Frank-Caro. The same principle is applied in both and the differences between them are minor. Crushed peat is fed into a furnace in which combustion is regulated by steam and hot air. The peat burns at the bottom of the feed shaft, and, reacting upon the steam, forms water gas and ammonia. The gases are next cleansed of tar by means of a scrubber and are subjected to a fine shower of sulphuric acid, which converts the ammonia into ammonium sulphate and purifies the gas. After being cooled the gas may be used under steam boilers, in internal combustion engines, and for other purposes.

In the United States records of only a small number of experiments with peat in gas producers are available, and seemingly very few tests have been made. The two experimental runs made in 1905 and 1906 at the fuel testing plant of the United States Geological Survey at St. Louis, Mo., are of importance and interest not only because they were probably the first trials in this country of peat in a gas producer, but because they were made in a large pressure producer built to use anthracite. In the first of these tests air-dried machine peat from near Halifax, Mass., was used. The average calorific value of the gas was 166 B. t. u. per cubic foot. The second test was incomplete because of insufficient peat. The peat came from Florida and gave 175 B. t. u. per cubic foot. A third test was made in a down-draft producer designed for bituminous fuels at the fuel testing plant of the United States Geological Survey at Pittsburgh, in January, 1909, with air-dried peat from North Carolina. The average calorific value of the gas was 109 B. t. u. per cubic foot, about the average value of the gas obtained from coal in this type of producer. Tests with coal under the same conditions as the first two above tests with peat yielded from 142 to 164 B. t. u. From these results it is apparent that none of the coals gave as rich a gas as the Florida peat, and gas from the Masschusetts peat was better than the average of that made from the coal. Aithough too much emphasis must not be laid on the results of a single experimental run or on two tests,

manifestly the value of peat as a fuel is greatly increased by the use of a gas producer. In the first two cases cited, under rigid test conditions in a gas producer designed for a very different sort of fuel, the peat, with a calorific value ratio to bituminous coal of 1:1.8, gave more power by being gasified and then used in a gas engine than an equal weight of coal did by being used to generate steam for a steam engine.

Gas producing plants using peat fuel have been operated in England, Ireland, Germany, Sweden, Italy, and Russia, but in the United States they have never advanced beyond the experimental stage. The only American experiment now in progress is that of the Minnesota Bureau of Mines, which will be watched with interest. One of the most successful peat gas plants in Europe is operated at Cordigoro, Italy.

Peat consumed in a properly designed gas producer yields gas of good quality and in abundant quantity in comparison with the yield from coal, and also many valuable by-products. This is one of the most effective methods of utilizing peat fuel for generating heat and power, because peat that is to be used in this way does not need to be so carefully prepared nor so thoroughly dried as peat that is to be consumed under steam boilers.

Production Methods and Equipment

In the United States and Canada hand labor is too expensive to be extensively employed in the production of fuel. The basis of peat production in this country and our northern neighbors is therefore the machine process. It consists essentially of an excavator, grinder or macerator, spreader, means for turning the blocks of peat, and a harvester. The ideal machine would combine all, but thus far this combination has not been obtained. The purpose of the macerator is to grind the constituents of the wet peat as it comes from the bog into a homogenous pasty mass which may be shaped into compact blocks. In 1907 an experiment was made by the United States Geological Survey with a macerating machine, and it was found that the macerating and shaping into blocks could be done for about $1.00 per ton. The machine was ex-

hibited and operated at the national exposition in Jamestown, Virginia, in 1907. Since then from 5,000 to 20,000 tons a year have been made according to this principle by various small commercial plants throughout the United States. The principal producers were F. H. Fallows, of Auburn, Me., Roger Upton, Marblehead, Mass., and the New Era Development Co., of Boston Mass. Some of the peat was sold for steam raising but it was largely used for domestic purposes, on account of the small plants and output.

The coal supply in the Central Provinces of Canada is below normal requirements and there has been much interest

ANREP PEAT MACHINE.

in peat there for many years. In consequence the Canadian Government has been very active in peat experimentation Several years ago Anrep and Nystrom, the Government's peat specialists, were sent to Europe to study European methods, and the outcome of this work was the Anrep peat machine, which has formed the basis for most American machinery since that date. The machine is illustrated by the accompanying photograph. It is a combination of excavating and macer-

ating devices. The operation of the excavating device is obvious from the photogroph. The macerator, which performs perhaps the most important function, consists of a cylindrical shell, inside of which is a set of spiral rotating knives and a set of knives fixed to the inside of the cylinder. The peat brought by the excavator to the hopper is forced by spiral knives through and against the fixed knives. The fibers, roots, and pieces of wood which are often found throughout the bog are cut or ground into small fragments, and the peat composing the various layers of the bog is thoroughly mixed into a homogeneous pasty mess.

The next step in the process is the spreading. An improvement in the Anrep method has been made by E. V. Moore of Montreal, Canada. He has combined equipment for spreading and harvesting peat fuel with the Anrep machine and the combined method is known as the Anrep-Moore process. It is the most efficient that has been operated in North America. According to the former process the spreading was a separate operation, like the harvesting, but by the latter method it is a continuous operation.

As the peat is spread in a layer from 3 to 6 inches thick it is moulded into blocks that dry to a moisture content of 25 to 30 per cent in the sun and wind, and are ready for harvesting in a few weeks. The only hand work is the turning of the blocks and the shoveling of the fuel into the harvester. The Moore conveyer permits the spreading of wet peat in one part of the field and the harvesting of the dried fuel with the same device in another part.

A few years ago a committee was appointed by the Dominion Government and the Government of Ontario for the purpose of making an experiment that could be considered of commercial proportions on the bog at Alfred, and if successful the project would be turned over to private parties for permanent operation. Two installations, one the Anrep and another the Moore-Anrep, have been in operation for several seasons. E. V. Moore is the engineer in charge. The Government work will be brought to a conclusion and a

report of the results made at the end of the present air-drying season. Mr. Moore will not release cost figures in advance of the final report, but from a close study of his process and operating data it is evident that the work has been the most successful peat fuel operation in North America. Thousands of tons of peat suitable for steam raising and other industrial purposes, as well as domestic use, have been produced at low cost. A detailed report will appear the next Journal.

PEAT DEPOSITS OF INDIANA.[1]

By W. N. Logan
State Geologist.

One of the important mineral resources of Indiana is comprised of its peat deposits, of which there is little general knowledge. The development of this resource as a fuel has been retarded largely because of the abundance of other types of fuel, and partly because of other less prominent limiting factors.

At the time of the coming of the early pioneers to the territory of Indiana, about eighty-five per cent of its area was covered with forests containing an immense growth of timber. The remnants of these gigantic forests still continue to contribute to the State's fuel requirements, and though greatly depleted they still supply a considerable part of our fuel needs.

At a later period in the history of Indiana our rich coal deposits were discovered and subsequently developed through the influence of the iron and other associated industries. This developed resource has added greatly to our fuel supply.

Later on came the discovery of natural gas and petroleum within the State in abundance and these natural products served to still further meet the demands for fuel. All of these were supplied to the consumer, until within recent years, at a very low cost. Through it all there has been little necessity for exploiting peat as a fuel. Such has been our fuel situation up to the present time and such, with one exception, the situation may continue for a considerable period. The one exception, at least, is that there will be no more fuel at low cost to the consumer as has been true in the past. The fuel resources of Indiana are being depleted rapidly. The forests have all but disappeared, the natural gas and

[1] Read at the Sixteenth Annual Convention of the American Peat Society.

petroleum supplies are waning, the most accessible and economically minable coal beds are being exploited. The time may not be far distant when we will be driven by rapidly increasing prices to seek other sources of fuel supply; for as our fuel supplies wane our fuel demands increase. The present high price of coal has forced the use of peat in some localities.

In 1900 Indiana produced about six and one-half millions tons of coal and in 1920 our production was nearly five times as much, being thirty millions tons. Within the same period our per capita production had increased from less than three tons to about ten tons.

These increasing demands being made upon our fuel supplies should serve to draw our attention to those possible latent supplies which grim necessity may force us to exploit in the not far distant future.

But, however important the peat of Indiana may prove to be as a fuel, it is probably not in this capacity that it will be found to be of greatest value to the State. Its potential value may be greatest in its usefulness of agriculture. Large areas of our soils have been depleted of essential plant foods. These essential elements must be restored in order that the productivity of our lands may not fall below the point of profitable farming. Our peat deposits lie easily accessible to large areas of good farming lands. They are often closely associated with beds of calcareous marl, which are useful in destroying soil acidity and in producing conditions favorable to cultivation and the fixation of nitrogen.

Distribution.

As will be seen from the map, the peat deposits of Indiana are located principally in the three northern tiers of countries, lying between the Wabash River and the northern boundary of the State. These deposits lie largely within the area covered by the Wisconsin drift, though there are some isolated areas beyond the Wisconsin in the Illinoisan drift and minor deposits in the driftless area.

In quantity of peat the ten leading counties in order of their rank are:

1. St. Joseph
2. Kosciusko
3. Starke
4. Steuben
5. Marshall
6. Elkhart
7. Lake
8. Noble
9. Jasper
10. Lagrange.

Origin.

The peat deposits of Indiana have accumulated in the basins of lakes and former lakes, in marshes, to a very limited extent in the abandoned channels of streams and in depressions formed by the shifting of sand dunes and in depressions formed by the damming of stream channels by shifting sands.

In northern Indiana where the glacial drift reaches its maximum thickness there exist on the surface of the drift numerous depressions which have given rise to lake basins and marshes in and around which the vegetation forming the peat had its growth. This process of vegetable accumulation which had its inception with the retreat of the glacial ice is still in progress. However, there are grounds for the belief that the rate of accumulation is slower now than formerly. There are at least two factors which may have influenced the change. In the first place it seems probable that at sometime after the retreat of the ice climatic conditions were more favorable to the growth and accumulation of vegetation than during the present climatic period. The second factor lies in the changes produced by man. These changes are found the cutting of the forests, the draining of lakes and swamps, lowering the water table, and the cultivation and pasturing of low-lying areas.

Favorable Conditions for the Accumulation of Peat.

The essential conditions for the growth and accumulation of peat forming vegetation are largely topographic and climate.

Topographic Conditions.

The essential topography is that which presents an area pitted with depressions bounded by higher lands, depressions in which the run-off of the region may be stored. The glacial drift region of the northern states presents such a topographic area. The finger, kettle hole, and other forms of depressions left by the retreat of the ice formed the basins for the numerous lakes of Indiana and the neighboring states. It is in and around these basins that the proper moisture conditions were found for the growth and preservation of the different forms of vegetation which contributed to our peat deposits.

Climatic Conditions.

Some of the essential climate conditions are: A relatively high humidity, a medium annual temperature, a moderate length of summer season, the absence of strong prevailing winds, and a moderately low summer temperature. The humidity of the region must be such as to maintain a fairly constant supply of water, so that there will not be a very great variation in lake or ground water level. There must be present at all times in the depressions of accumulation a sufficient supply of moisture to produce favorable growth and to protect the accumulating vegetation from too rapid recay. No deposits of peat of consequence have been formed in arid or semi-arid regions. Not only must there be an abundance of moisture, but its supply must not be intermittent.

Extremely high temperatures are not conducive to the formation of peat deposits, even in the presence of abundant moisture as in the tropics and semi-tropics. This condition is due, probably, to the fact that high temperatures are favorable to vegetable decay, being conducive to rapid oxidation and to bio-chemical changes, which are held in check by lower temperatures.

Long summer seasons are favorable to plant growth, but on the other hand they are accompanied by higher temperatures, which are favorable to plant decay. Short summers are not favorable to extensive plant growth. It is the happy mean between these two extremes which seems to be the most favorable for the formation of peat.

Where strong winds prevail in lake regions the vegetation which grows on the surface and in the shallow water is broken up by the waves and tossed upon the shores to decay. Thus vigorous wave action prevents the formation of peat beds.

Thus we owe our peat deposits to the fact that the northern part of Indiana is favorably situated with reference to topography and to climate.

Varieties of Peat.

Considering the predominant type of vegetation, there are two varieties of peat in Indiana. The first is a moss variety composed largely of the fibers of the moss, Sphagnum cymbiofolium, but containing smaller quantities of other mosses and other plants. This variety has a higher fuel value than the grass-sedge variety, which made up largely of grasses, sedges and other coarser plants. These two varieties grade into each other so that a great many sub-types could be named. Several other classes or types could be named, such as bog peat, swamp peat, tuff peat, muck and others. Johnson's classification includes the common types in Indiana. These varieties are: 1. Turfy peat, composed of slightly decomposed mosses and other peat-producing plants, having a yellow or yellowish brown color, very soft, spongy and elastic; specific gravity, 0.11 to 0.26, weighing from 7 to 16 lbs. per cu. ft. 2. Fibrous peat, unripe peat which is brown or black in color, less elastic than turfy peat, the fibers either of moss, grass roots, leaves or wood, distinguishable by the eye, but brittle and easily broken; specific gravity, 0.24 to 0.27, weight from 15 to 42 lbs. per cubic foot. 3. Earthy peat, nearly or altogether destitute of fibrous structure, drying to earthlike masses which break with more or less difficulty, giving lusterless surfaces of fracture; specific gravity, 0.41 to 0.90, the full cubic foot weighing from 25 to 56 pounds. 4. Pitchy peat, dense; when dry, hard; often resisting the blows of a hammer, breaking with a smooth, sometimes lustrous, fracture into sharp-angled pieces; specific gravity, 0.62 to 1.03, weighing from 38 to 65 pounds per cubic foot.

Properties.

The color of Indiana peat varies from light brown to pitch black though dark brown is the prevailing color at the surface of the deposit and black in the lower portion of the deposit. The color of many of the muck deposits is bluish-black when wet and dark gray or brown when dry.

Specific Gravity.

The specific gravity of Indiana peat ranges from 0.11 to 1.02 and its weight per cubic foot from 7 to 65 pounds.

The average of the analyses of five samples of Indiana peat which were analyzed by Dr. R. E. Lyons, of Indiana University, exhibits the following chemical composition:

Water at 105° C.	11.99
Volatile matter, air dried	88.49
Fixed carbon	22.00
Coke	31.51
Ash	9.51
Nitrogen	2.99
Sulphur, oven dried	.74
Phosphoric acid in ash	1.36
Potash in ash	1.22

Fuel Value.

The fuel value in British Thermal Units of 55 samples of Indiana peat was determined by Lyons and Cooper. The lowest recorded B. T. U. value was 4,542 and the highest in the 55 samples was 10,466. The average was 8,469 B. T. U.

Uses.

Indiana peat may be used for a variety of purposes. Among others may be mentioned fuel, in the manufacture of gas, as a fertilizer and fertilizer filler, in the manufacture of peat mull, as an absorbent, for packing purposes, in the manufacture of paper and paper boards, as a stable litter, and in the preparation of stock food.

As a fuel, better grades of Indiana peat may be used. The calorific power of air-dried peat is a little more than half that

of anthracite coal. The kiln-dried peat has about the same calorific value as dry lignite or about seventy per cent of that of anthracite coal. The heating value of one pound of the best coal of Indiana is equal to the heating value of 1.26 pounds of oven-dried Indiana peat.

Peat charcoal and peat coke, both of which are useful in metallurgical processes, may be manufactured from Indiana peat.

Gas has been manufactured from peat. The composition of the gas obtained from the use of peat is very similar to the composition of the gas obtained from the use of coal except that there is an absence of phosphorus and sulphur in peat gas.

Peat fiber, or peat litter, is prepared from peat by the removal of the finer particles and the earthy matter. The peat fiber may be used as an absorbent and deodorizer in stables and slaughter houses, containing liquids of fertilizing value which is desirable to conserve. It is also used as an absorbent for the uncrystallized residue from beat and cane sugar refining.

Peat fiber may also be used in the manufacture of paper and fiber boards. In the manufacture of stock food, peat is dried, partly carbonized, screened and reduced to a powder which contains about ten per cent of moisture. The powdered peat may be used to absorb liquid foods or may be mixed with dry ingredients.

As a fertilizer, peat may be applied directly or it may be used as fertilizer filler. This is one of the most important uses to which the peat of Indiana can be applied. The peat of Indiana contains about three per cent of nitrogen and smaller amounts of potash and phosphoric acid, all essential plant foods.

Peat may be used as a base for complete commercial fertilizers containing phosphorus and potash compounds. It may be used, also, as a culture medium for the growth and distribution of nitrogen-fixing bacteria in the soil. The soluble nitrogen content of peat may be greatly increased by treating the peat with a dilute solution of ammonium sulphate and then inoculating it with nitrifying bacteria. By repeated treatments it may be made to yield as much as 4 per cent of nitrates.

The fertilizing effects may be increased by adding tricalcium phosphate to the bacterized peat, which when applied to the soil may react in such a way as to free its natural potash content.

The accessibility of peat and marl deposits to excellent farm lands in Indiana and the low expense of applying these products to the land should render these resources of very great value to the agricultural interests of the State; and I am hopeful of a more extended use of them in the near future.

The writer desires to acknowledge his indebtedness to written and published papers of Davis, Taylor, Johnson, Soper and Osborn, especially to "The Peat Deposits of Northern Indiana", by A. E. Taylor, Ind. Geol. and Nat. Res. 31st Ann. Rept. 1906, and to the discussion of peat in Indiana by E. K. Soper and C. C. Osborn in Bulletin 728, United States Geological Survey, the proofs of which articles were furnished the writer through the kindness of Mr. Osborn.

NEWS OF THE INDUSTRY.

Massachusetts

It is reported that a $25,000,000 company is being founded in Boston to market and sell peat in New England.

Norwood and other communities adjacent to Boston have extensive fields of the raw product. It was stated last year on good authority that there are 20,000,000 acres of peat lands in the United States and 30,000,000 acres in Canada. Over 12,000,000 cords of the substance are supposed to be in Massachusetts.

Several other attempts to refine the raw peat have been made in New England, but never was the venture attempted on such a large scale as the coropration now being formed.

According to Dr. John Mickelborough, a geologist, there are large peat beds all through New England and vast quantities also exist in the dismal swamp of Virginia. The Encyclopedia Britannica states that there are enormous deposits in the United States and Canada and that they have been but little used.

Several weeks ago peat was discovered in Bridgewater by Eben Brown, who is now using the substance for fuel. Peat was discovered in Plymouth in 1917, and in Brockton the following year.—Beverly, Mass. Times.

The production of peat as a coal substitute may be undertaken within a short time if a deal now pending for the sale of the peat bog above Hall's ground in Clarksburg to a Boston concern is completed, it became known today.

George W. Hall of Clarksburg, owner of the bog in the tract of land known as Hall's ground, just above the Briggsville settlement, stated when questioned on the matter, that a deal has been pending for some time for the sale of the property to a Boston company, but added that as yet the transfer has not been made.

Mr. Hall, several years ago, discovered the presence or

peat in what appeared to be large quantities, in the bog. Several experiments that he attempted at that time proved its value as a fuel, but because of the expense which would have been involved in bringing the peat out in quantities, its production as a commercial proposition was never undertaken. If the sale now projected is consummated, however, the necessary machinery may be brought here within a short time and the peat taken out and prepared for sale in place of coal.—No. Adams, Mass., Transcript.

Enough fuel to keep East Boston warm all winter has been unearthed in excavating for the new Elevated tunnel on Chelsea street, below Maverick square. It is a five-foot layer of peat and thousands of tons have been discovered. Whether or not it can profitably be used for fuel is a matter for the Boston transit commission to determine.

Peat has been found in Boston in years gone by but not in any great quantity. The quality just unearthed is known as stone turf. European countries use it to a great extent, after it has been put through a drying process. Peat gives two-thirds of the amount of heat from anthracite coal. Transit Chairman Thomas A. Sullivan believes that it can be utilized for fuel on the stationary engines being used on the tunnel job. Mr. Sullivan visited the scene of the discovery yesterday with Charles J. O'Malley, an expert on the use of peat.

—Boston Post.

Michigan

Edward D. Wholihan was recently elected president and John H. Collins, secretary-treasurer and general manager of the Peat Products Corporation of Detroit, at a meeting of the stockholders. The company is incorporated for $100,000. The bog from which the peat will be obtained is a 440 acre tract near Eaton Rapids. Buildings have already been constructed and plans have been made for production of 100 tons of dried peat a day within the next 30 days.

—Battle Creek, Mich., Inquirer.

Minnesota

Peat—which during the forest fires in the north county became a potential menace to the lives of many settlers in that territory—may be helpful to many farmers facing a coal storage this winter.

So declared W. R. Appleby, director of the mines experimental station, University of Minnesota, who, with Prof. Peter Christianson, former president of the American Peat society, but now an instructor at the university, is prescribing the best methods of utilizing this fuel.

Evidence, of the interest taken by many farmers who have empty-coal bins, with prospects of their being filled quite remote, is seen in the numerous inquiries received by Profs. Appleby and Christianson, the mines station director declared.

To the person wishing to store up peat fuel for the winter, Prof. Appleby recommends the simplest method, as follows:

Select a drained bog where the peat is at least four feet thick. Dig down as far as practicable with a sharp, flat ditching spade. Prepare a bank like face from which blocks of the peat may be cut with ease—blocks a trifle larger than building brick. An old knife, such as used for cutting stacked hay, is a good implement for manning the vertical, or up and down, cuts. A ditching spade may be used for the horizontal incisions.

To dry the peat, the blocks should be stood on edge with air spaces between them. Where the peat is not fibrous, as may be the case well below the surface, and crumbles easily, it may be mixed with water and kneeded into the consistency of ordinary mortar and then spread out on the smooth surface of the bog to a depth of about four inches and allowed to drain. After drained it may be cut into bricks.

An intensely hot fire, such as is suitable for all kinds of domestic and power purposes, can be produced with a moderate draft.—Sioux City, Iowa, Journal.

New York

There are vast peat bogs in the northern section of New York State, covering in many instances hundreds of acres, A recent report made by John M.. Clarke, State geologist, shows that peat cutting in certain sections of the State was an industry forty years ago, and that additional research relative to the extent of peat bogs will bring to light the fact that many acres of drained land contain peat in large quantities.

The report of Dr. Clarke refers to peat in New York State in this fashion:-

"Peat bogs are present in many parts of the State, and altogether cover an extensive area. The most reliable estimates place the swamp lands at about five per cent of the entire surface, which is 49,204 square miles.

"The most extensive group of swamps is found in the Finger Lakes region and the lowlands near the St. Lawrence River, though the largest swamps of all—the drowned lands of the Walkill—are in the mountainous part of Orange County which borders New Jersey.

"Many peat deposits are found in the Adirondacks, and as exploration is carried farther the recorded number will be much greater. The depth of the Adirondack swamps is likely to be much greater than most of the swamps in the central and western portions of the State.

"The report also shows that it is estimated that a thousand acres of peat land are to be found in New York, Westchester and Putnam counties, with a probable yield of two million cords. Much of this land, it is pointed out, has been converted to other uses in New York and Westchester counties."—New York Telegram.

J. H. Snyder of Sodus, has purchased a peat tract of about 500 acres near Savannah, the deal having been made with an Albany party. Mr. Snyder is the largest operator of muck land in this section of the state and during the ten years has made a specialty of growing celery.

He has the only irrigation system on a large basis in this part of the vegetable belt. He has not yet announced

how he will develop his new property in the vicinity of the Montezuma stretches.—Rochester, N. Y., Herald.

Pennsylvania

Bradley L. Skinner recently told a representative of The Daily News that he had discovered peat on his farm in Buckingham township, located 500 yards east of the Holicong post office, on the Old York Road. The peat was found in a low place on the Skinner farm.

Mr. Skinner says he has experimented with this peat and found its fuel value low, but the equivalent of wood. When burned in a stove, he says, it makes a slow, steady fire.

The peat found in Buckingham can be used only for household purposes as it is not rich enough to be of value for industrial use.

It is believed that peat also exists in bogs generally throughout the Buckingham district.

Doylestown, Pa., News.

Germany

Extraction of Gas From Peat in Germany.

Successful experiments have been conducted in Germany in obtaining gas from peat. This extraction is one of the main substitute measures adopted perforce in the reconstruction of German economic life, particularly its industries, where the shortage of coal has been the great problem. In some cases it is said to have been possible to convert coal-gas furnaces to peat-gas furnaces, which is looked upon as a salvation for a heretofore almost useless and dormant national resource. The use of peat as a means of power has, however, been confined to the districts adjacent to the peat bogs, owing to the high freight rates which must be paid for transporting water-laden peat and the cost of driving off the moisture by heat. In the utlization of this product for power two fundamental difficulties are involved—the high percentage of water and the unfavorable granulation. Though the water content could be

reduced by air drying, the perceptibility of moisture is objectionable.

The best way to use the gas produced from peat is to extract the water by cooling the gas. This gas is said to produce higher temperature than could be produced through the combustion of bituminous coal. A great difficulty at first experienced in extracting gas from peat was the distillation of tar products which condensed easily, choked the pipes, and caused disturbance in using the gas in motors. A remedy was found by separating these valuable tars from the gas and utilizing them.—Commerce Reports.

The more or less successful installations in northwest Germany for the utilization of the immense peat bogs that exist there has led to the suggestion in England that the huge bog of Allen in Ireland may next become a great center of industry. The German undertaking has contemplated the bringing of a large part of the bogs under cultivation, together with the conversion of the peat into fuel, to be employed in the development of electrical energy for power to a number of towns situated within a radius of fifty miles. A network of canals is, it is reported, in process of formation to drain the ground, and the peat dredged out is to be utilized in the way just described. It is estimated that the gas produced from the peat will furnish work to the amount of 600 horse-power for each ton, and a large quantity of ammonia will be recovered for use as fertilizer.

—Washington Star.

NEWS OF THE SOCIETY.

Illinois.

The John Crerar Library, of Chicago, has been a member of the society for several years. It is a privately endowed free public reference library of scientific and technical literature. It has at present nearly 500,000 volumes and 300,000 pamphlets on the subjects included in this field. Its reading public consists of the physicians, engineers, chemists, business men, teachers and similar classes in the community.

Michigan.

Mr. Geo. H. Kimball, Consulting Engineer of Detroit, Michigan, states that since boyhood, when he saw peat cut by hand for fuel the subject has had a fascination for him. As a consulting engineer he has for some years kept abreast of the subject in order to advise as occasion might demand.

He has no holdings as yet but keeps up quiet investigation with a view to purchase a lease. Michigan affords many opportunities.

There is one phase of the subject that is of special interest to him: the making of alcohol from certain grades of peat. Some years ago there was published an account of the process. The information was carefully filed but has been lost or mislaid and he is unable to trace it. If members have any source of information on that matter will they kindly advise him.

Minnesota.

In 1919 Professor E. K. Soper, through the Minnesota Geological Survey, published Bulletin 16 on the Peat Deposits of Minnesota. In that report he stated that there were 5,000,000 acres of peat of an average thickness of five feet or more, or a tonnage of 6,835,300,000 tons of air dried machine peat fuel. Of this enormous acreage the state owns close to

one-fifth in its several trust funds. The state then has a direct interest in its development and use as well as an indirect one in the promotion of the general welfare of its citizens through the utilization of this vast amount of potential wealth. The State University is carrying on experiments in testing its fuel and metallurgical properties.

The Department of Mines, which operates under the direction of R. P. Chase, State Auditor, and a member of the society, has the custody of all state lands. It has done considerable work in the line of using peat to heat its office buildings at Hibbing, bringing the merits of peat in its simplest form to the attention of the people, and in connection with the beneficiation of iron ores. Demonstrations of its use in the form of cut peat, machine peat, briquetted peat, as a binder for fire ores and fuel and in gasified form have been made at state and county fairs and development meetings. Much interest has been awakened and many farmers have reported that they are using cut peat for fuel. Their activities are limited by the amount of money available for the purpose of demonstrations. Several companies are in the process of formation looking to the promotion of the peat industry in the state.

The agricultural uses of peat are beginning to be appreciated in Minnesota. The Agricultural College has done and is doing a splendid work in showing the people what may be done with peat lands. The legislature has given the school small funds for demonstration purposes and some truly remarkable work has been done in several parts of the state under the direction of Dr. F. J. Alway. The state owns several hundred thousand acres of peat lands that are more suitable for agricultural than as possible sources of fuel. Interest in the development of both phases of the peat industry in Minnesota, is rapidly awakening and a definite program for its utilization will be in full force in the near future without doubt.

Mr. L. B. Arnold, long an active member of the society, makes the following report of his interests in peat:

"Replying to your letter of the 4th instant received yesterday, I am interested in the American Peat Society as manager of over a half millions acres of lands received by rail-

roads under State Swamp Land Grants which provide that over 50% of each forty acre tract or Government sub-division must be swamp land.

"It is my position to find such uses for this land as will enable us to dispose of it to people who will put it to practical use. This means development of demand for peat land for agricultural, fuel or any other purpose.

"Up to the present time, our work has been principally along the development of peat lands for agricultural purposes; and we are carrying on a very considerable development project with a reasonable amount of success.

"We are now undertaking investigation of peat development along other lines.

"Our agricultural development work is carried on in close conjunction with the Soils Department of the University of Minnesota, Dr. F. J. Alway in charge, and under the supervision of our own Agricultural Engineer, Mr. Wallace Ashby.

"We have had considerable investigation of the peat soils in our locality by Professor E. K. Soper, by the late Dr. Davis and Dr. Dachnowski of the Bureau of Plant Industry.

"In connection with this work, the County of St. Louis no has some five hundred miles of drainage ditches and we are now principally interested in securing plans for practical water control of such lands for sub-irrigation and growing crop.

"For any detail in connection with this work, I would refer you to Mr. Wallace Ashby, Agricultural Engineer, Duluth & Iron Range Railroad Company, Meadowlands, Minnesota; for practical information in regard to drainage, sub-irrigation, etc., would refer you to Mr. Thomas F. McGilvray, County Engineer, in Charge of Drainage Systems, Court House, Duluth. These two gentlemen are perhaps the best posted along their special lines of any men I know of.

New York.

The General Briquetting Co., 25 Broad St., New York, N. Y., are engaged in the development of methods for briquetting peat fuel. This company is a member of the society and persons interested in this phase of peat are referred to them.

Mr. F. P. Coffin, of the General Electric Comapny, Research Laboratory, Schenectady, N. Y., has long been a peat booster. His interest in peat however, is entirely of an academic nature at present. He is interested in following the progress of the arts of fuel utilization and power generation, and is carrying on experimental research in connection with the last named subject. In connection with the first subject, he is the author of Chapters V to VIII, inclusive, of the McGraw-Hill Book Company's new book on American Fuels. The general subjects covered include the newer methods of making prepared fuels from coal and peat which are of present or future interest in connection with the generation of power. The major subjects include pulverized fuel, by-product producer gas, and the distillation of coal at low temperature. He has included a brief review of the possibilities of utilizing peat in the by-product gas producer. A part of this review was published in the Journal of the American Peat Society for October 1921.

ABSTRACTS OF PATENTS.

Drying Peats and Lignite.

By N. Testrup.

A film or layer of moist peat, lignite, or other material having like properties when moist, is formed upon the periphery of a rotating drying-drum by pressing the material against the heated drying-surface by means of a roller of smaller size moving peripherally at a speed so much lower that the film adheres to the drying-surface in a practically unbroken layer. Peat, for example, containing between 70 and 90 per cent of water, may be fed into the V-shaped trough between two cylinders, the larger of which revolves at between two and three times the speed of the smaller feed-roller. The material adheres to the surface of the drying-cylinder , which may be roughened to facilitate the adhesion, until, when dried, it is removed by a scraper and transferred to a conveyer. The vapor evolved by the material may be heated by compression, as described in specifications 149,055 and 150,068, and employed in heating the drying-drum.

—British Patent 178,636.

Drying Peat.

By J. Moeller.

Raw or partially dried peat is formed into hollow balls and heated. The raw peat is conveyed to the mixer from which it is discharged in the form of hollow cylindrical blocks on to drying-shelves, the shelves being suspended from a frame and adapted to be shaken so that the blocks roll slowly down the shelves into a trough from which they are conveyed to a ball-making machine. A mixture of hot air and steam is forced over the blocks on the shelves through nozzles by a fan, the shelves having at their ends adjustable flaps to control the flow of air and steam. At the ball-making machine, the blocks

are remixed and formed into hollow cylindrical blocks in a casing containing a screw-conveyer, orifice pin, and having a rotary cutter at its outlet, the blocks falling into a rotary ball-making cylinder. The blocks lie between the surfaces of screw conveyer in the cylinder and by the rotation of both the cylinder and screw are formed into hollow balls and discharged through the orifice on the driving-shelves of the type described above. The drying-shelves may be supported in a building heated by waste products.—British Patent 178,475.

BIBLIOGRAPHIC REVIEWS.

A Handbook on the Winning and Utlization of Peat, 1917, by A. Hausdig. Translated from the 3rd German ed., by Hugh Ryan, D. Sc., Prof. of Chemistry in the University College, Dublin, 1921. Printed by the Department of Scientific & Industrial Research. Fuel Research Board, England.

The third edition of this handbook again advocates careful attention to the utilization of bogs from an economic point of view. Particulars are given for the encouragement of the industry, and careful attention is paid to the use of peat for power and fuel purposes in the glass and ceramic industries, as well as in agricultural lines.

The volume is divided into two parts: Part I, covering the subject of the winning of peat; Part II, that of the utilization of peat. A general review of the origin, types, chemical and physical characteristics of peat is given in the first chapter of Part I, as an introduction to the subject. Under each part, a chapter is devoted to patents relating to the subject discussed, and both parts conclude with a summary of notes referring to the text. Not only are the methods and machinery described, but full discussions consider the advantages and disadvantages of each.

The book is written in an interesting and readable style, containing many tables of comparisons and diagrams of machinery illustrating the text. The author had forseen the necessity of a handbook covering the peat industry and as such the volume proves a useful guide to those interested in this natural resource of a country.

S. LINKER.

Occurrence and Uses of Peat in the United States, by E. K. Soper and C. C. Osborn: U. S. Geol. Survey Bulletin 728, Washington, D. C.

This report, which contains the results of studies undertaken during the World War, describes peat deposits of the

region lying east of the ninety-seventh meridian and north of an irregular line drawn eastward through the northern parts of Iowa, Illinois, Indiana, Ohio, Pennsylvania, and New Jersey, including approximately the area covered by the Wisconsin or last glacial drift, a relatively narrow strip of land extending 25 to 50 miles inland on the Atlantic coast from New Jersey to southern Florida and along the Gulf coast to the Mexican boundary; and small scattered areas in the Pacific Coast States. These regions include practically all the valuable peat deposits in this country and nearly all the swamp land except the bayous and lowlands along the Mississippi, where peat can not form because the water contains too much sediment and the heavy rainfall is unevenly distributed throughout the year.

It has been known for many years that the United States contains large deposits of peat, but little detailed information concerning the quantity and quality of this peat or the uses for which it is best adapted has heretofore been available except some reports on the peat deposits of Maine and a few other States. This report is intended to show the method of formation, distribution, quantity, and quality of the peat in the United States, to indicate the uses for which it is best suited, to point out the possibilities offered by the commercial utilization of peat, and to serve as a guide for future investigations. It contains conclusions based on a study of the origin, occurrence, and distribution of peat in the areas considered, a general account of the uses of peat and peat moss for fertilizer, fuel, surgical dressings, and other purposes, and descriptions of the methods of measuring and testing deposits and of the processes of manufacturing peat products; but as complete descriptions of machinery and manufacturing methods are given in other publications, references to which will be found in this report, the technical features of the work of peat production are treated only briefly.

The report is profusely illustrated and contains a large table of analyses.

Arrangements have been made whereby every member of the American Peat Society will be furnished a free copy.

C. C. Osborn.

ADVERTISEMENTS

Journal of the
American Peat Society

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PRELIMINARY REPORT OF CANADIAN PEAT FUEL COMMITTEE

The original objective which the Joint Peat Committee had in 1918, the year of its appointment, was the testing of peat machines under commercial conditions, in order to determine if a type suitable for manufacturing peat fuel on a commercial basis could be developed. By a process of elimination two types were selected, the well known Anrep peat machine, largely used in European countries—in the smaller sizes—and the Moore machine. The latter, while not fully developed, appeared to possess so many obvious advantages that the Federal Government, before the appointment of the Peat Committee, decided that it should be given a trial.

On account of the precedence given to war contracts, the two machines were not delivered at the Alfred bog, Ontario, until the Spring of 1919, and their erection was only completed in time to enable a short mechanical try-out to be conducted before cold weather set in. It was not, therefore, until the Spring and Summer of 1920 that manufacturing operations were actually begun.

Up to this time the Committee was under the impression that its work would be completed at the conclusion of 1920 and that sufficient data would be available to enable an opinion to be expressed concerning the commercial possibilities of the two machines. The results of that season's operations, however, disclosed inherent weaknesses in both plants, and the Committee was unable to approve either

type for commercial work. Recognizing the great value of a healthy peat development to the Dominion at large, the Committee recommended that a new combination be effected embodying the best features of the two types which had been tried out. This recommendation was approved by the two Governments and funds were allotted for carrying out the construction and operation of the new combination. The construction was completed late in 1921 and operations were concluded in 1922.

Development of Peat Machinery

The success of any such machine depends largely upon the elimination of manual labor to the greatest extent possible and on the production of a manufacturing unit of large capacity at the lowest possible cost commensurate with good service.

Attempts to meet these two conditions led to the trial of many mechanical advices which heretofore have not been used in this connection. The most noteworthy features involved were the adoption of caterpillar aprons and the substitution of a portable belt conveyor and automatic spreading machinery for the track system and field presses formerly employed. The development of these and other mechanical features proved difficult and occasioned the expenditure of much time. While the machine has not actually been constructed to the design which the Committee esteems would be reasonably free from defects, the problems involved have, in their opinion, been thoroughly investigated, and drawings for a complete standard equipment with power plant, pulverizing unit, conveyor and spreading system are now under way.

Necessity for Further Government Operation

While the Committee has completed research work requisite to the development of a successful peat manufacturing plant, and is able to place at the disposal of those interested, construction data and operating statistics, it is of opinion that the establishment of a peat industry is of such importance to Canada and especially the province of

Ontario, that the Governments should undertake the construction and operation of a perfected plant until its possibilities are fully demonstrated.

Cost of Manufacturing Fuel with the Combination Plant

The Committee after careful consideration arbitrarily fixed the price f. o. b. cars peat plant siding, at which peat fuel could in its opinion be sold for consumption, within a 100-mile radius and still compete with anthracite coal. The price was $5.00 per ton of standard peat fuel (containing 30 per cent moisture, and comprises the following items:

1. Production cost
2. Overhead charges
3. Manufacturer's profit

The production cost depends mainly upon the cost of the raw material, the prevailing price of labor, the number of employees, seasonal variations, and the quantity of salable fuel produced per unit per working season. Overhead charges include interest on capital invested, depreciation and administration, and manufacturer's profits as would be arrived at by the investor.

The figures employed in this report are considered fair by the Committee, but those who desire to engage in such an enterprise would naturally estimate their own overhead charges and profit.

In order to keep items 1 and 2 sufficiently low to enable a fair manufacturer's profit to be realized and still bring the selling price of peat f. o. b. cars within the limit of $5.00, it was estimated that the minimum capacity of a unit must be 10,000 short tons of salable standard peat fuel for a work-season of one hundred days. This type of machine should be capable of producing a sufficiently high hourly average of peat fuel throughout an entire season, irrespective of seasonal variations and delays due to breakdowns or other causes, to enable the 10,000 ton figure to be realized. This we believe could be accomplished by constructing the complete unit sufficiently large to produce a maximum capacity considerably in excess of the minimum required.

The improved plant, exclusive of harvesting equipment, consists of four components:

1. Excavating
2. Macerating
3. Distributing and spreading
4. Power

The excavating element proved of sufficient capacity to meet all requirements, and the distributing and spreading system was sufficient to deliver and spread the maximum quantity of peat excavated. The macerating element, however, failed to deliver the required quantity with the power available. This was due to the adoption of a new type of macerator, a "Swing Hammer Pulverizer," which it was considered would prove far more reliable, cheaper and more efficient than the Anrep macerator heretofore employed. This machine had not before been employed for macerating peat, and, therefore, its capacity and the power required to operate it for such purpose were not known. A portion of the operating season had to be devoted to experimentation with and calibration of this unit.

On account of the lateness of the season, and lack of funds the Committee could not possibly consider the purchase of a power plant sufficient to operate the combined plant to full capacity. The power plant used was improvised, comprising two boilers already on the bog, the wasteful steam engines which formed part of the two plants previously experimented with, and a high speed engine which was rented for the season. The two boilers were rated at 80 horsepower each and the engineer of the Committee had reason to believe that practically 160 horsepower would be available. A test, however, disclosed that only 110 horsepower could be developed while the minimum required to operate the full capacity was estimated to be 150 horsepower. With 150 horsepower and a larger macerator the full capacity of the plant could have been delivered. Since both these elements are standard equipment and can be obtained in various sizes on the market, the ultimate capacity of the plant can readily be obtained by simply substituting a macerator and power plant of greater capacity.

Costs

Based on the performance of the experimental combination plant and the estimated cost of an entirely new and remodelled plant, complete with an efficient power unit and larger macerator, the production and other costs of the finished peat per ton are estimated to be:

	10 hour day	20 hour day
Production costs	$2.00	$2.00
Overhead charges	2.48	1.50

or a total cost of finished peat fuel, on board cars at siding of plant of $4.48 for a ten-hour day for a season of 100 days, or $3.50 for a twenty-hour day during the same season. A total production of salable fuel in the first case is 10,000 short tons and in the second, 20,000 short tons. Since, however, the overhead costs mount rapidly as the production decreases the Committee recommended that plants of this type should be operated for twenty hours per day. The necessity for increasing the length of the working season by operating twenty hours per day will be readily appreciated, when it is realized that the considerable investment represented in plant is, under the most favorable conditions, lying idle practically two-thirds of the year. Thus the overhead would be distributed over the production of only one-third of a year thus greatly increasing the cost. Working two shifts is equivalent to operating ten hours a day for 200 days. Night operation with this combined plant is entirely feasible; it was not the case with either of the others.

The foregoing costs are below that arbitrarily set by the Committee, as the maximum price at which peat could be sold f. o. b. plant and still compete with coal for domestic purposes. The most notable feature is the marked reduction in the total cost due to reduction in overhead, by operating for a season of two thousand hours instead of one thousand.

The important reductions in the final total cost will be attained by many improvements permitting of substantial saving in the construction of a new plant, and by the employ-

to consumers should be in the neighborhood of $10.00 per ton ment of a self-contained Diesel engine electric power plant. By using Diesel engines and electric generators, and operating all drives on plant with electric motors, it is estimated that a saving of 85 cents per ton of salable peat fuel will be realized over that possible with the inefficient outfit employed this season. Those figures assume the employment of this or some other equally efficient power plant. For a plant producing ten thousand tons, in 1,000 hours, a power equipment of 200 horsepower will be required. The following table recites the estimated costs of building an entirely new plant with power, harvesting, loading equipment and other accessories. Overhead and administration charges are also shown.

TABLE OF NEW PLANT COSTS

	Capital Cost	Depreciation	Administration
Power plant	$25,000.00	10%—$2,500.00	
			10% on $100,000.00
Peat plant	$35,000.00	20%— 7,000.00	for 20 hrs. daily operation
Harvesting equipment	$25,000.00	14%— 3,500.00	or
Buildings, Equipment and Miscellaneous	$5,000.00	10%— 500.00	10% on $50,000.00 for 10 hrs. daily operation
Total	$90,000.00	7% $6,300. $13,500.	$10,000. or $5,000.

MARKET

A good market has been developed for peat within the economical shipping radius of the Alfred bog. The demand is growing. The success of such a plant depends in a marked measure, however, upon the site chosen for manufacturing in its relation to points of consumption. This should be selected with a view to eliminating long rail hauls. The economic limit depends not only upon freight rates, but on the price of other available competitive fuel. For example, the cost of anthracite to consumers has an effect upon the price at which peat fuel can be sold at the same point. It is the opinion of the Committee that the price of peat fuel delivered

if the bogs are strategically situated with respect to transportation facilities and within 100 miles of the market.

Plant No. 3 Small Peat Plant

When Plant No. 3, the small plant, was first designed an attempt was made to combine the excavating and macerating units in a single machine, simple in design and inexpensive. Until the end of the season of 1921 efforts were made to perfect the original design, but the results were not satisfactory. Difficulties with the combined excavator and macerator were not completely overcome and it was decided that other means of macerating must be found before this type of machine could be deemed practical from a commercial standpoint. About this time the possibilities of the Swing Hammer Pulverizer were brought to the notice of the Committee and nothing further was done with No. 3 until this machine had been tried out.

The Swing Hammer Pulverizer proved to be so superior to the type of macerator formerly used that it was decided to include it in the rebuilding of No. 3. This was carried out during the 1922 season. Construction, however, was only completed after the normal working season and, therefore, no sustained demonstration was possible. The troubles which developed in the first design were overcome. The capacity of No. 3 plant should be not less than 1½ tons standard fuel per hour and in regular operation might exceed this. The cost of construction cannot be given at this time as new drawings have to be prepared. It is, however, expected that it will not exceed $5,000. A full description of the re-designed machine with a discussion of its capabilities, and accurate figures of its cost will be given in the final report of the Committee. Three men should be sufficient to operate it.

(Sgd.) A. A. COLE,
Chairman Peat Committee
B. F. HAANEL
Sec'y Peat Com.

Toronto, Ontario, Dec. 5, 1922.

PEAT AS A FERTILIZER INGREDIENT.[1]

By Fred Wiedmer,
President of Wiedmer Chemical Co.

During the war the question of fertilizers became one of great importance to every person in the United States, as a world's food shortage was predicted and any tonic on the worn out soil that would add an extra grain to the ear of corn or a potato to the hill was in demand. While the possibilities of peat had long been known as a fertilizer, it was hard to convince the various State chemists that certain kinds of peat as now treated were among the best plant foods obtainable. The shortage of fertilizer created by the war helped get peat on the market and the results were gratifying.

I say certain kinds of peat as treated. That is what I want to dwell on. Peat beds or bogs are found in almost every State in the Union, and usually in low marshy places, as decayed vegetable matter and water are necessary for formation of peat. These peat beds in their natural state are generally sour and contain acids harmful to alkaline soil crops. The treatment that is needed to eliminate this is first to drain the bog with ditches so that the top of the bog is at least 4 to 6 feet above the water level in the ditches, and second to cultivate, aerate, and sweeten the soil and rot the fibers and roots. The peat is thus transformed into a rich humus or loam free from harmful acids and in this state it is ready to separate, dry mechanically, pulverize, and screen, and it is then ready for the market. Peat treated and manufactured in this manner is transformed from its raw state into a rich vegetable humus which, when used in complete fertilizers as a base is of great assistance in bringing back soil to its virgin state. It is admitted by State chemists, Farm bureaus, and practi-

[1] Read at the Sixteenth Annual Convention of the American Peat Society.

cal farmers that peat is a great absorbent of water, and during the dry periods in summer it holds the moisture in the soil. This is one of its merits in addition to its plant food content.

The largest fertilizer manufacturers in this country have bought and still buy humus from us for use in compounding fertilizers. Peat is also used extensively on golf courses.

The beneficial result of mixing peat rich in humus with soils on golf courses lies in the increased capacity of the soil to absorb and retain moisture, and the lightening and aerating of the soil so that it will not pack or cake and the roots will get nitrogen.

As a base it is used in the manufacture of fertilizers. There is apparently no doubt but that there is no material used for the purpose that has so few objectionable features and so many desirable properties, not the least of which are its great absorbing and deodorizing qualities, and its ability to prevent caking of fertilizer mixtures. If the fertilizer manufacturers would consider that these are important properties of the peat, as well as its ability to add an amount of nitrogen to their analyses, it is probable that a greater demand would be made for peat.

Now the use of peat in a commercial fertilizer has been objected to in some States. I believe Indiana limits the amount allowed per ton on the ground that the nitrogen in peat is insoluble and unavailable. In the first place, as I have stated, there are different kinds of peat. In some the nitrogen is much more soluble and available than in others, and each brand of peat should stand on its own merits. The only correct means of determining the availability consists of making actual growing tests and studying the yields obtained. When this is done with properly prepared peat the results are out of all proportion to what might be expected from a study of the chemical analysis for availability, and until these compounds and their action on plants are known, and until the action of the compounds formed by them during their decomposition in the soil has been determined, the question of the availability of

peat as a plant food cannot be completely understood. As I have seen the results of what our peat or humus will do, I think the best and only way to keep humus on the market and get the price it is worth is to encourage the farm bureaus to make growing tests. If our peat society could keep in touch with them and get the actual results, and if we could get the data on the results from the commercial fertilizers that contain peat as a base and the ones in which it is not used, I am satisfied the kinds with a peat base will show up the better and if used year after year they will soon restore the soil to its original rich virgin condition.

THE FLORIDA EVERGLADES.

By Robert Ranson
Member Executive Committee and former Vice President of American Peat Society

Four million acres more or less are included in that tract of land at the South end of the Peninsula of Florida known as the Everglades and to the initiated might be well described as one immense peat bog. In the Glades may be found practically every kind of peat known to peaters from the richest, black colloidal, decayed matter to the lightest brown fibrous peat, the darker kinds however predominating. The whole consists of really three basins, one within the other. Centrally located East and West, but a little to the north of the whole tract, lies Lake Okeechobee containing about 1,200 square miles of pure soft fresh water. About 16 miles from the edge of the lake rises a rim of muck land, and say 16 miles further is the real rim of the Glades, the whole of which lies superimposed on a bed of limestone rock. Like all peat bogs, parts of it have been found capable of raising large crops, and on other parts the best and up-to-date farmers have utterly failed.

As long ago as 1845 the Government in Washington began to take an interest in the possibilities of this vast tract and at different times surveys were ordered and reports made, and occasionally companies formed to drain these solitudes for the growing of sugar cane which seemed the most desirable crop for this land and to which the climate was eminently suited.

Many failures resulted and from this experience was gained. About 1906 the State Government began first to actively attempt to drain the Glades by a system of canals depending solely on gravity to get rid of the water, there being an alleged fall from Lake Okeechobee to the sea on either side of the Peninsula of about 18 feet. So far they have made but little impression on the whole, though vast

quantities of water have been carried off. This section has always been and always will be subject to long spells of drought and long seasons of rain, so that in the dry times the average observer says the Glades are overdrained and in wet times they should have four times as many canals to carry off the surplus waters. In my opinion from the cultivators' standpoint the whole plan of reclamation is faulty and impossible and only such a plan of reclamation will ever make these broad acres safe for cultivation as follows the methods used in the low countries of Holland, where operations are carried on behind dikes and where the water levels can be controlled to a point consistent with safe cultivation. However, from our standpoint let us regard the whole from the standpoint of the recovery and use of the peat, for all purposes for which peat is or can be used.

Shallow on the margins, deep towards the middle, we can safely rely on an average depth of muck and peat over the whole of not less than eight feet. I have made soundings that show from one foot to twenty-three. Its average nitrogen content over the whole taken from several hundred soundings in different places and reported on in a special bulletin by the State Chemist is 3.15, so from the ammonia by-product recovery point of view it runs very high and promises excellent results with proper plant installation.

Its average ash content is low and makes it a very desirable fuel, running from eight to eleven per cent.

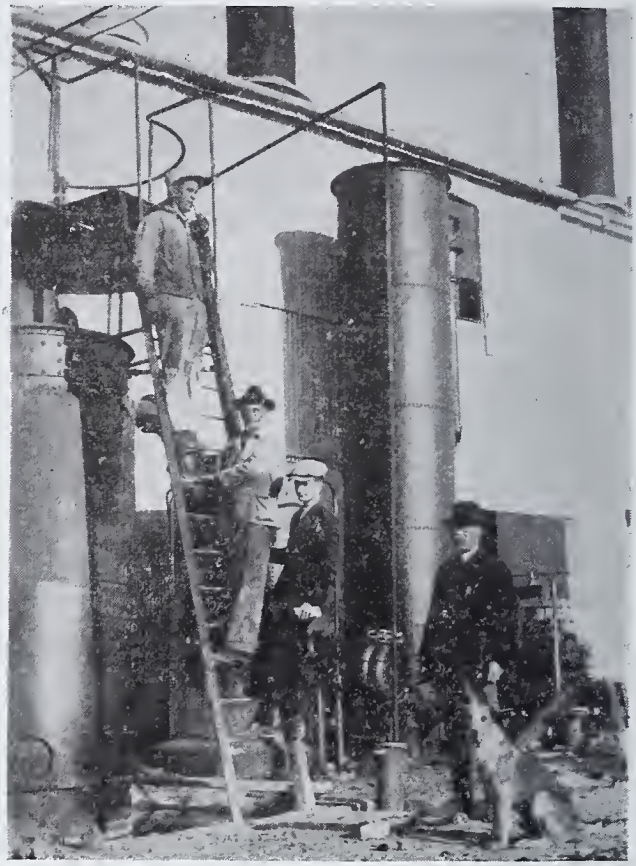
Its B. t. u. runs about 9,000 when down to 17 per cent moisture content. The volatile carbon about doubles its fixed carbon, the exact opposite of the average coal which thus makes it a high grade gas producer, though a low grade fuel burned on ordinary grates. When reduced to a fine powder it is my opinion that it is unsurpassed as a fuel, as we get not only its fuel value as a fuel, but this form of combustion develops its volatile content immediately and we get a readily combustible gas which really burns, whereas if fed into furnaces in lump form much of the gas produced by the surrounding heat goes up the flues and

escapes unburnt, since there is too long an interval between the production of the gas and its coming in contact with the heated furnace walls for it to take fire.

It may be of interest to readers to know that I have found a very satisfactory combination of producer gas from peat with dust peat fuel, and such a combination will be found a wonderful saving, as in gathering the peat much of it is too fine for producer firing and this rendered still finer in a suitable grinding mill enables us to use all the gathered material. When in 1911 I was visiting the large Mond plant in the province of Hanover which supplied the City of Osnabruck with light, heat and power and which has been written up from time to time in this journal by Dr. Haanel, I found a vast wastage in fines which might easily have been burned to great advantage under boilers as a steam raising fuel. Probably the latest and best installation of this kind was put in last year by the Tennesse Coal and Iron Company at Ansley, Alabama, in a large battery of B. & W. Stirling boilers fired by producer gas and dust coal, and while the subject is under discussion it is interesting to note that a cube of peat or coal one inch square which presents to the fire only six square inches of surface, when reduced to dust fuel, presents a surface of from 25 to 26 square feet. My belief is that the gases produced from the burning peat dust have a far greater chance of being completely consumed than the gases liberated in burning lump peat fuel, in which case the processes of production being comparatively slow, they escape unconsumed up the flues.

Whether from the fuel, gas, fertilizer or by-product point of view, it is difficult to find a more suitable peat deposit anywhere in the United States. We have a very pleasant, equable climate permitting of work practically the year round. The average rainfall is about 60 inches somewhat less than the annual evaporation, and we can depend on about 300 clear days in the year. With the figures at hand as to peat gasification now being used in many places in Europe, together with by-product recovery, which have been vastly improved in the past decade, and the constant-

ly increasing demand for cheaper light, heat and power in the rapidly growing towns in South Florida, it would seem that several plants of units of consumption of from 115 to 120 tons of air dried peat daily might become very profitable ventures. My ambition is to produce sufficient current



Trial peat gas producer at the sugar mill, Canal Point, Fla. This producer is burning Everglades peat and producing 100 H. P. in gas engine. It was erected by Robert Ranson, during the summer of 1922.

to electrify the Florida East Coast railway from Jacksonville to Key West which, with its branches, is about 700 miles long and as the by-product production in ammonia and tar far more than pay a high rate of interest on the necessary investment, we have the fuel absolutely free of all cost and thus the only further expense would be the

necessary boilers and turbo-generators to produce the power. It is to be hoped that some time this year, say in November, it may be possible for the American Peat Society to meet at Palm Beach and take an excursion over the vast tract of land known as the Glades, which can be done by boat in one day. At the present time we are using peat both in solid and gaseous forms to fire the boilers of the Florida Sugar & Food Products Company's sugar mill near the great Lake of Okeechobee 1,200 square miles in extent.

Our results to date have been encouraging and with additional capital shortly promised I am hoping to develop my plans to their ultimate and logical conclusion. The Glades as a whole are in a fuel-less country, as no timber grows on them, and it would seem to be another wise provision of the Creator that we should, as it were, be living on the top of a low grade coal mine.

Experiments so far show a gasification of about 100,000 cubic feet of producer gas per ton of a thermal value of about 175 B. t. u. per cubic foot and an ammonia recovery in the form of sulphate of 216 pounds per short ton with about six per cent of tar.

BEHAVIOR OF CEMENT MORTAR AND CONCRETE IN SOME GERMAN BOGS.[1]

By F. J. Alway

The long delayed report[2] of the special sub-committee (Moorausschuss) of the German Committee on Reinforced Concrete has finally appeared. The experiments were conducted at the national bureau for testing materials in Berlin (Materialprüfungsamt) and in the laboratory of the German Association of Portland Cement Manufacturers at Karlshorst. The report includes a preface giving an excellent review of the literature, from 1905 to 1921, dealing with the action of peats and bog waters upon concrete structures. For the convenience of those who do not have access to the report some of the most important parts are given in this paper.

The first important reference to injury to concrete in contact with peat appears to be that of Thörner describing the now famous Osnabrück case[3], in which a cement drain partly laid in peat in 1903 showed serious injury after a few months' use. The deterioration was found to be due to the oxidation of the unusually large amount of iron sulphide contained in the peat, forming sulphuric acid and ferrous sulphate.

At its meeting at Darmstadt in October, 1908, the Committee on Reinforced Concrete appointed a sub-committee (Moorausschuss) of seven, including Gary, the author of the present report, and to this entrusted the testing of the

[1] Published with the approval of the Director as Paper No. 365 of the Journal Series of the Minnesota Agricultural Experiment Station.

[2] Gary, M.—Versuche uber das Verhalten von Mortel und Beton im Moor. Deutscher Ausschuss fur Eisenbeton, Heft 49. Berlin, 1922. 172 pp., 59 illustrations. Published by Wilhelm Ernst & Sohn, Berlin, W 66, Wilhelmstr. 90.

[3] This was described in a recent number of this Journal.—Disintegration of cement tile in peat, by F. J. Alway. vol. 15, no. 3, p. 15-22 (July, 1922).

points in controversy, these having been raised by the case at Osnabrück and the subsequent publications. The task of the sub-committee as defined was "to determine by practical trials whether the different kinds of concrete are suitable for foundations in high-moors and low-moors[1], to what attacks they are exposed and how such attacks can be avoided or rendered harmless." Distinction was to be made between concrete made with pure water and that made with bog water and also between well cured and green concrete.

The experiments fall into two groups, viz., the preliminary experiments with cubes and tablets of cement mortar exposed from 1910 to 1913 and the main experiments with concrete structures put in position in the bogs in 1912 and removed partly in 1914 and partly in 1920 for laboratory investigation.

Experiments With Cement Mortars

For the trials of different mortars the sub-committee selected seven sites. Five of these were near Lübeck, three being on the Elb-Trave canal, which cuts thru a low moor[1] carrying considerable iron sulphide and two on the Kehdingen high moor. On the Elb-Trave canal each site was to represent a specific condition, viz.:

No. 1, at Siebeneichen—Peat with a low content of iron sulphide.

No. 2, at Woltersdorf—Peat with a medium content of iron sulphide.

No. 3, at Güster—Peat with a high content of iron sulphide.

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[1] Peat soils fall into two great groups—**high-lime** and **low-lime**—when considered from the standpoint of agricultural reclamation. Liming is one of the indispensable measures in making low-lime peats productive of ordinary farm crops, but it is of no benefit on high-lime peats. The two groups are characterized chemically by a difference in the content of lime (CaO), as determined by incineration and extraction of the resulting ash with aqua regia. On the basis of data on Minnesota soils the high-lime group may be assumed to include all those with 1.20 per cent or more of lime and the low-lime group those with less than 0.80 per cent. Those with from 0.80 to 1.20 per cent are to be considered as peats of **doubtful lime requirement,** permitting classification only after a vegetation or field experiment, but these form only an almost negligible proportion of the whole, our peats usaully being either distinctly low-lime or distinctly high-lime.

The high-moors have a slightly convex surface and all are low-lime bogs, while the low-moors are flat or even slightly lower in the center than at the margin, and, with an occasional exception, are high-lime bogs.

In the Kehdingen moor one set of samples to be tested was placed from 1 to 1.5 meters deep in the peat and the other in the main drainage ditch where they were directly in contact with the flowing bog water. The other two sites were in the extensive low-lime bog at Bernau in southern Bavaria, both in drainage ditches, one in flowing and the other in quiet water.

To determine the influence of the three variables—cement, sand and water—a large number of samples of mortar were prepared, using four different cements, five different sands, two mixtures (1:2 and 1:5) and both pure water and bog water. In the spring of 1910 these sets were put in place at the seven sites mentioned as well as in both fresh water and sea water and all kept under observation for three years. Determinations of volume and crushing strength were made after six months exposure and again after three years.

The strength of the samples exposed to bog water was found to be less than that of those kept in fresh water. At the end of 6 months a slight effect was observable but after three years it was much more distinct. The lean mixtures suffered more than the rich from bog water and the longer the exposure the greater the difference. There was more injury from the flowing bog water than from the quiet but the difference became distinct only after the lapse of years. The strength of the mortar samples in flowing bog water decreased 22 per cent between the 6 months and the 3 years tests.

There were marked differences in degree of injury from site to site. The most was found in the flowing bog water at Bernau, less in the quiet water there, still less in the flowing water of the Kehdingen bog, and even still less in the quiet water. Along the Elbe-Trave canal very little injury was observed at Siebeneichen, where there was least iron sulphide, but more at Woltersdorf and Güster. The character of the sand influenced the durability of the samples. While differences in the effect of the various cements were evident the resistance to injury from bog water was not directly related to the strength of the cement.

A detailed chemical examination was made of the mortar samples after they were removed from the sites. Chemical changes were slight during the first six months but increased with time and in two cases the samples had fully disintegrated at the end of three years. The analyses showed so many contradictory results that generalizations are difficult. The character of the mixing water had no influence upon the resistance. The lean mixtures, being more porous than the rich, were more altered. The chemical effect was most dependent upon the site. Flowing bog water attacked the mortar more than still bog water and the high-moor more than the low-moor. Without accompanying determinations of strength chemical analyses are liable to lead to erroneous conclusions concerning the weakening of the mortar.

Experiments With Concrete

The most important work of the sub-committee was the testing of concrete structures at three sites, viz., at Güster on the Elb-Trave canal, where iron sulphide was most abundant in the low-moor, in the Kehdingen high-moor and in fresh water at Trebbin. In 1912, at each place, large concrete tile, reinforced piles in which the concrete was poured, as well as tamped concrete piles and pillars cast in place, were put in and since then have been kept under observation, part being removed for laboratory examination in the summer of 1914, others in the summer of 1920, while still others have been left in place for future examination. As the tile presented a large surface to the attack of the bog water and on one of the two bogs showed serious injury during the eight years' exposure, while the pillars and piles were at most but little effected, the following discussion will be confined almost exclusively to the tile. In the original the piles and pillars, about 90 at each site, are dealt with exhaustively.

The tile had an inner diameter of 29.5 cm. and a wall thickness of 4 to 4.5 cm. and were so supported that they were at the average water level in the bog. All were made at the same factory and 90 or more shipped to each of the three sites after they had been well air-cured. Two cements and four different sands were used. One fourth of each lot was

prepared with the addition of potash soap, 5 kilos dissolved in every 100 litres of mixing water, and another fourth was made by adding 6 litres of Tirili emulsion to every 100 litres of water. Half of the remainder, made with tap water, received two coats of the black, coal tar coating known as Siderosthen-Lubrose. There were thus ten or twelve lots of differently prepared tiles exposed to the bog water at each of the three places. The table, in which are summarized a part of the data, will serve to illustrate, each datum being the average for three tiles.

No.	Sand	Cement	Protective Material	Average crushing strength after 2 years at Kehdingen Kilograms	8 years at Kehdingen Kilograms	8 years at Guester Kilograms	8 years at Trebbin Kilograms
1	Kehdingen	B	None	3,887	2,950	4,183**	3,450
2	,,	,,	Siderosthen	3.533	2,910	4,063**	2,913
3	,,	,,	Tirili	2,853	1,760	3,180**	3,067
4	,,	,,	Potash soap	1,950	580	2,000**	3,083
5	Isar	,,	None	3,265	2,140	2,997**	2,977
6	,,	,,	Siderosthen	3,513	3,090	2,450**	2,613
7	,,	,,	Tirili	3,357	2,990	1,460**	3,473
8	,,	,,	Potash soap	All broken	2,030	0 * **	3,117
9	Kehdingen	G	None	3,357	2,670	.....	**3,057
10	,,	,,	Siderosthen	3,617	2,890	.....	**3,793
11	,,	,,	Potash soap	2,025	1,730	.....	**3,523
12	,,	,,	Tirili	1,680	1,430	.....	**3,430

All were put in place early in the fall of 1912. Early in the fall of 1914 three tiles from each lot were removed, examined and subjected to a crushing test. Three more from each lot were similarly treated in the summer of 1920.

The injury was greatest in the Kehdingen bog; in the Güster bog the effect was slight during the first two years but increased with time; and even in the fresh water at Trebbin the strength decreased slightly between the second and eighth year. The tar coating was of little or no benefit while the addition of potash soap or the emulsion even increased the injury. The character of both sand and cement influenced the durability of the tile. The committee's conclusions may well be quoted in full:

* All three tiles had disintegrated.

** At Trebbin Freienwald instead of Kehdingen sand was used with cement G, while at Guester it was used with both cements B and G.

"The following conclusions may be drawn from the behavior of the tiles during their exposure of almost 8 years:

"Thin walled cement bodies, such as the tile used, are not able to withstand the action of acid bog water for a long time. For buildings in bogs the careful choice of cement and aggregate is a necessary prerequisite for the greatest durability. Good cements and clean quartz sand of mixed grain sizes behave best. If cement and aggregate are carefully selected protective coatings may be dispensed with. So called water-repelling additions of Tirili and potash soap have an injurious action in the acid bog waters. The thick pillars and piles will evidently withstand the action of the bog waters for many years without suffering an appreciable loss in strength and bearing power."

The sub-committee recommends for tiles to be laid in bogs the use of a mixture of one part of asphalt with ten parts of coal tar, dipping the tile into the hot mixture, and a similar treatment is desirable for piles.

This special sub-committee has been continued with 6 active members and 8 advisory members, including Br. Tacke, director of the Bremen Moor-Versuchs-Station. It is now trying to determine whether some cements are not more durable than others in bog water and whether coatings may not be found to afford protection to concrete surfaces for a long time.

Action of Hydrogen Sulphide

The sub-committee devoted considerable attention to the effect of hydrogen sulphide upon cement, mortar and concrete, and concludes that when the calcium sulphydrate, formed as the first reaction product, undergoes oxidation, calcium sulphate is the final but not the first product, calcium thiosulphate and the calcium thionates being intermediate. In order that injury may result it is not necessary that calcium sulphate be formed, as the calcium sulphyrate is soluble in water and may be dissolved out of the concrete. The sub-committee also concludes that the attack of hydrogen sulphide is greatly hindered, if not entirely prevented, when in the process of curing $CaCO_3$ takes the place of $Ca(OH)_2$, and so it emphasizes the importance of using well cured and well aged concrete made with a dense mixture.

Conclusion

The report is certainly not encouraging to the use of

concrete tile in peat and muck soils, but we should remember that the task of the sub-committee was not to attempt to ascertain how large a proportion of peat soils will permit of the use of concrete without serious deterioration but to determine to what attacks concrete is exposed in bogs and how these may be avoided or their severity lessened. It selected the sites for the preliminary trials in the bogs only after making sure that harmful conditions existed in each—iron sulphide along the Elb-Trave canal and low-lime peat at Kehdingen and Bernau—while for the final trials with concrete on the Elb-Trave canal it selected the site where the preliminary trials had shown that the severest injury was to be expected.

It is highly desirable that examinations be made of the concrete tile that have been laid for some years in the bogs in different parts of this country. Wherever serious injury is found, such investigations should include the examination of the adjacent peat for the presence of iron sulphide (pyrite or marcasite) and soluble sulphates and also, wherever the peat is found to show a very strongly acid reaction, the determination of the lime content.

FOR THE GOOD OF THE ORDER.

The editor of this journal is endeavoring to make it of interest and value to members of the society and to the industry. He can not perform this function efficiently and effectively without the co-operation of the membership. If he is not satisfying members of the American Peat Society, they are invited to correspond with him on the subject or upon any subject pertaining to peat and muck. Suggestions for the improvement of the journal and the welfare of the society are welcomed. His name and address will be found on the inside of the front cover of this magazine.

The editor feels that members should take a more active interest in the affairs of the society and the industry. A feeling of greater solidarity and mutual interest should be fostered. In order to promote mutuality of interest he is attempting to present in each number of the magazine a summary of the news of the society obtained by him through direct correspondence. He attempts to keep in touch with every member of the society.

The annual convention is another means of bringing members together and of promoting fellowship. The next convention will, as usual, be held in the fall. Members are invited to correspond with the executive committee and to present their views concerning the locality in which the next convention should be held.

SECRETARY AMERICAN PEAT SOCIETY
2 Rector Street,
New York, N. Y.

Dear Sir:

Below you will find names and addresses of men interested in peat and muck who would probably be interested in the journal of this society.

NAME	ADDRESS	OCCUPATION

Yours truly,

_____

Address _____

NEWS OF THE INDUSTRY.

Agronomists Select Analyses For Middle West

At a meeting in Chicago last month between agronomists from five of the Mid-western agricultural colleges and representatives of the fertilizer industry, agreement was reached regarding the fertilizer analyses required to meet the needs of the principal crops grown in their States. Instead of the comparatively large number of grades now registered for sale, both groups agreed to actively promote the use of the following fifteen analyses:

For Mineral Soils		For Organic Soils (Muck and Peat)
0-12-6	3-12-4	0-8-24
0-14-4	3-8-6	0-10-10 or 0-12-12
2-12-2	4-8-6	
2-12-4	4-12-0	
2-12-6	2-14-2	2-8-16
2-16-2		

—Nat. Fertilizer Ass'n, December, 1922

Massachusetts

Work will be started within six weeks or two months in the using of the peat now in the peat meadows in the vicinity of Newton Square, Worcester, as a substitute for coal. A large machine is to be installed in the meadows, which will cause the peat when shoveled into the machine to come out in the form of carbonite bricklets.

Behind this deal is the Massachusetts Carbon Fuel Co., Inc., a corporation composed of Worcester capitalists. The company is capitalized under the laws of Massachusetts for $1,000,000 and shares will sell at $10 par value. Among the Worcester men connected with the new company are President, J. A. Horton, also inventor of the carbonite making machine; H. A. Wilber, treasurer; Fred E. Townsend,

clerk; A. M. Hart, George B. Cutting, Edward N. Cummins and the above-named officers comprise the board of directors.

The company proposes to place the new substitute for coal on the market next fall and agree to undersell the coal dealers by at least $5 a ton.—Worcester Post, Feb. 23, 1923.

Maine

A resolution calling for the investigation of the practicability of using the peat deposits for Maine for fuel purposes, to relieve future fuel shortage, will be introduced in the House at an early date by Representative Rounds of Portland.

"There are deposits of peat in Cape Elizabeth, Scarboro, Mt. Desert, Greene, Bangor and Lewiston," says Mr. Rounds, "which if they can be utilized, might furnish cheap fuel for the people of Maine for many years to come."

Mr. Rounds says that the peat deposits in the vicinity of Lewiston were utilized fifty years ago, being made fit for fuel by a crude system of air compression. Use of the peat was abandoned during the years when coal became cheap and has not been revived in the recent years of high priced coal.

Mr. Rounds has been in communication with government experts and men familiar with the treatment of peat in Wales as to methods of compression and drying to render the peat fit for fuel. He believes that the Maine peat supply may be handled so as to greatly relieve the fuel situation.—Portland Press Herald, Jan. 18, 1923.

Michigan

Ann Arbor, Mich.—In the excavations being made on the campus of the University of Michigan for the literary building and the physics building, Prof. H. H. Bartlett has discovered pellets of peat which will, it is believed, be of great scientific value.

It is believed this discovery will enable scientists to de-

termine the type of vegetation existing in the glacial period. According to Prof. Bartlett's theory, these pellets came from a peat bed that existed during the glacial period, disintegrated in the break-up and was carried out with the gravel.

The pellets found here are two and three inches across. They have no commercial value.—Morristown (N. J.) Jerseyman, Jan. 12, 1923.

New Jersey

Peat again may become available for fuel in Jersey marsh districts, which have dried up as a result of the prolonged drought. Years ago natives of the pine belt gathered peat for fuel, but wood, charcoal and anthracite were more easily secured and handled, and the peat mines were abandoned. Never has the need for some available fuel been more acute.

There are some large deposits of peat in various sections of the State. Not for more than a century have conditions been so favorable for digging peat, as the marshes and bogs are now so dry that it is possible to drive teams over them. Jersey farmers say that during a dry spell a year ago one of these dried-out bogs caught fire and the peat burned underground over a large area for several days before a heavy rain again flooded the bog and extinguished the flames.

Many of these deposits are on marshy sections of farms which owners have regarded largely as worthless.

The Government estimates that only 100,000 tons of peat are used annually in this country, while in Europe fifty million tons of peat are used every year for fuel.—Phila. Public Ledger, December 5, 1922.

New York

Peat dug out of the ground in which it has laid for years, is being used as fuel by James Ciarcia, contractor, in his steam shovel on North Third avenue, Mount Vernon,

where a fifty-four inch drain is being installed to connect with the main trunk line at Temple Place.

The peat is being piled on the ground near the steam engine that propels the shovel and chunks of it, after being air dried, are thrown into the engine from time to time as a supplement to soft coal. Discovery of the substance has attracted wide attention.

It was said that the place is evidently a horseshoe water shed basin, where centuries of decayed vegetation has sunk down into the earth and formed fuel.

The fuel dug during the past week has been down about eight feet. The sloping land in the form of a horseshoe around, has carried this vegetation into this basin.

The horseshoe slope, it was said, begins at the Mount Vernon police station, continues along Fourth avenue to the high school and Gramation avenue, around behind Lincoln avenue and commencing to slope up Chester Hill east of Cottage Avenue and continuing to the railroad.—Port Chester (N. Y.) Item, Feb. 2, 1923.

It will be news to many New Yorkers that there is a deposit of good peat within the city limits which might be used locally as fuel. This deposit is at Juniper Swamp, Maspeth, L. I. The area is about 100 acres in extent, and the peat bed is from 10 to 15 feet thick. It is estimated that there is 42.000,000 cubic feet of easily accessible material which merely needs cutting out and drying to provide fuel for thousands of families. Ash left after burning is about 9 per cent of the weight of the peat as dried in open air.

Peat consists of disintegrated and partly decomposed vegetable matter, leaves, roots, and similar material. It collects in and fills up swamps under favorable conditions, and vast deposits of it are known in temperate and cold climates. When dried in the open air it forms a valuable domestic fuel, and its value is greatly enhanced by conversion into briquettes, either alone or in mixture with coal dust. Peat is much used as fuel in Ireland, Scotland and Continental Europe, and was burned in this country to some extent during Colonial times and even later, but the present

generation of Americans knows nothing of its value. It is estimated that there are 15,000,000,000 cubic feet of peat in Massachusetts alone, while the great dismal swamp of Virginia and North Carolina, 40 miles long and 25 miles wide, is practically an inexhaustible storehouse of the material.

At the Museum of Natural History various specimens are exhibited including dried natural peat, dried compressed peat and peat briquettes, and briquettes composed of ground peat mixed with coal dust.—New York Times.

Canada

A survey of the peat situation in Canada by the Can-

The recent state of the coal-mining industry in the United States, Canada's main source of supply, has caused that country to turn attention to the more general use of peat, of which there are large bogs located in Ontario. The lack of known coal resources in that province has made the problem one of paramount importance. Even when mines of the United States get back into their normal stride in a short time it is unlikely that the coal needs of Ontario will be fully supplied.

adian Pacific Railway shows that there are about 37,000 square miles of bogs in the Dominion and to date 105 have been surveyed with an aggregate area of approximately 224,131 acres. These contain 190,330,170 tons of fuel and 20,588,110 tons of litter.

Forty-six of these bogs which have been surveyed, are in the Province of Ontario, with a total area of 132,321 acres, containing in the neighborhood of 110,109,000 short tons of peat fuel, and 518,000 tons of peat litter. During the last year four bogs were surveyed in the province, a total of 11,089 acres being investigated. Three of the bogs are situated near the cities of Fort William and Port Arthur, and the fourth near Verona. All these areas were found to contain peat suitable for fuel.

The excessive moisture of peat in its natural form is one of the greatest drawbacks of successful production.

From 82 to 92 per cent of peat as it is found in nature is moisture and this must be reduced to 25 to 30 per cent before it can be used as an efficient fuel. In that form it is known as standard fuel, and has a heating value compared with anthracite of one and a half tons to one ton. The big advantage of peat over coal is the complete absence of ash, which in coal amounts to between 10 and 25 per cent. At present peat is advocated for cooking purposes, and in the furnaces during the fall and spring months.

Much money has been expended on experiments and improvements at Alfred, and production now ranges around eight tons an hour, although plans are under consideration for increasing the rate to ten tons, the only handicap being a lack of power. Investigations and experiments carried on there during the last year or so are now complete, and operations on a commercial scale have commenced. Production extends over a period of fifty to sixty days, or from May 1 to Aug. 31.

"There is an active demand for peat fuel," says a railroad bulletin, "orders coming in from widely separated points in Ontario, shipments being made to some twenty-odd towns. One or two trial shipments have been made to Montreal, but it is doubtful if a permanent market will be found there. According to the Hon. Harry Mills, Minister of Mines for Ontario, the entire output of the Alfred bog has been requisitioned by coal dealers as a substitute for coal. The gross tonnage will amount to approximately 5,000 and will retail to the consumer in Ottawa at $10.60 a ton and at Peterboro at $14 a ton.

"Canada annually expends huge sums on the importation of coal from the United States, and will continue to do so until by the further development of her own vast coal and coal substitute resources, the Dominion will be independent of outside sources for her fuel supplies. The development of the peat bogs at Alfred is a step in the right direction, and when the success which is being made of this venture by the government becomes known, it is safe to assume that private capital will become interested in

exploiting other bogs."—Saginaw (Mich.) News-Courier, December 24, 1922.

Ireland

The peat-cutting industry is carried on very profitably in Ireland. Work usually begins at the bogs at the end of April. The skilled cutter, who has two men with low sideless wheelbarrows in attendance, uses a kind of spade, called a slane, the sods being cut up and removed to dry land. A few days later, when the sods have become a little less soggy, they are spread carefully all over the ground and left to dry. The next step is to pile the turf into a skillfully-made heap, which allows the wind to pass between the different pieces. Usually it is two or three months before the peats are ready for use as fuel. Peat is used in Ireland to such an extent that few people in the country districts ever burn coal.—Beverly (Mass.) Times, Feb. 9, 1923.

Sweden

Leading European archaeologists express the opinion that a woolen garment discovered by peat cutters in Gerum Fen, near Skara, Sweden, is one of the oldest ever found in Europe. It lay only a few feet under the surface of the peat, but the preservation qualities of the fen water kept it intact, scientists believe, for about 3,000 years. The garment resembles a cloak.

The preservative powers of peat soil have long been recognized by the Irish and at one time it was their practice to bury butter during the summer for use in the winter. In 1906 some men cutting turf near Killucan found a tub containing about two hundredweight of butter buried deep in a bog.

From the style in which the tub was made it was surmised that the butter was over a hundred years old, yet it was not quite uneatable, though somewhat rancid. Similar deposits have been found in other parts of Ireland, some wrapped in cloth which on exposure to the air crumbled to dust.—K. C. Times and Chicago Post.

NEWS OF THE SOCIETY.

Michigan

Mr. A. B. Curtis, Manager of the Central Peat Corporation, of Capac, Michigan, writes as follows concerning the activities of his company.

The past year has been one of singular activity for this company, and we express sincere gratification to the thousands of patrons whose hearty and substantial response has encouraged us to broaden our operations and build up a business that will justify our unlimited faith in the peat industry.

The demand for our product, having exceeded all expectations, will exhaust our present supply in another month or six weeks. Then for a short period we shall mark time and take orders for spring deliveries, when field operations are resumed.

So far our energies have been confined to producing and marketing peat litter for poultry farms, stables, etc., but after careful and exhaustive experiments we have formulated plans for the introduction of new lines which will bring our peat into universal and daily use.

Our holdings comprise 500 acres of peat land, averaging 10 feet in depth. Below this is a deep bed of fine, valuable clay. Buildings of concrete and brick cover about 40,000 feet. We are located on the Grand Trunk main line with siding facilities for many cars a day.

It is our opinion that the tremendous possibilities for use of peat in the United States have scarcely been sounded. The field is unlimited and the subject so alluring that large capital will be enlisted, and through the guidance of able men with clear judgment, the peat industry will come into its own.

Mr. R. A. Smith, State Geologist of Michigan, says that peat has been the subject of much discussion in his State,

especially for the last few years with high priced and scarce coal. His organization have in mind the bringing of Dr. Davis' work on peat up to date by such field work and studies as may be necessary. He expects to publish something on peat as soon as the necessary funds can be provided. Allowances have been made for these funds in the State budget but must wait for approval by the present legislature.

Last summer the survey did considerable work on peat in Charlevoix County in cooperation with the University of Michigan, the Agricultural College, and the United States Bureau of Plant Industry. A brief report on the peat resources of this county will probably be published with the general report which will cover all of the resources including soils, forest growth, etc.

Minnesota

The following statement was furnished by the Payne Investment Company. Mr. G. H. Payne is an officer of the society.

In 1919 the Payne Investment Company of Omaha organized a syndicate with a capital of $1,000,000 and purchased approximately 15,000 acres of swamp land in Freeborn County, Minnesota, some 12 miles northeast of the thriving city of Albert Lea. The tract was practically all marsh land, and about 4,000 acres of the tract consists of pretty well decayed peat intermixed with a large proportion of decayed vegetation formed from the annual rotting of heavy growths of canebreaks, cattails and other swamp growth. In 1907 a canal had been built through this tract which removed the water from three small lakes, but left the land thoroughly saturated with water.

The entire tract has now been completely drained and about 8,000 acres of it is thoroughly tiled out and in the highest state of cultivation. A buckeye ditching machine was used to make ditches twelve feet wide and seven feet deep every half mile, and after the water had run out of the soil and had been carried away by these ditches so that the bottoms were dry, tile was laid and the ditches filled in,

leaving only a slight depression to carry off surface water. These ditches were made on each side of the roadways and the spoilbanks graded down and surfaced first with clay and then with gravel. There are now approximately 25 miles of well graveled roads on the tract. The land is producing such crops as 74 bushels of corn per acre, 68 bushels of oats per acre, 265 bushels of potatoes per acre, 17 tons of sugar beets per acre, and better than 3 tons of timothy and clover per acre from one cutting.

The 11,000 acres of mineral land is being sold to Hollanders for raising such crops as are mentioned above, and for dairy purposes. The company purchased about 400 head of young Holstein cows and is selling them off ten to fifteen to each of the new settlers, taking half the cream checks until the cows are paid for. A year ago at this time none of the settlers had made any improvements. Today there are twelve excellent sets of farm buildings on the land costing $6,000 to $10.000 each and twelve other sets are contracted for to be erected early this spring. It is expected that by the time snow flies next winter there will be 50 to 75 sets of nice buildings on the land.

The 4,000 acres of muck land is being sold to Dutch celery growers, several experienced celery men from Kalamazoo, Michigan, district having already purchased land. The quality of celery produced in 1922 was very fine indeed and topped the market in Omaha and Minneapolis. Indications point to the establishment here of a very successful celery industry. The soil is pronounced by experts to be fully the equal of any in the United States and as this tract enioys an advantage of $100 to $300 per car in freight and refrigeration charges over other celery districts shipping into the tributary territory, it should be very successful from a monetary point of view.

The Company is contributing $1 per acre towards the building of a Dutch Reformed Church and a parsonage has already been erected, leaving out the partitions for the present. This has been equipped with chairs, platform, pulpit and an organ and the Dutch people are holding services

therein every Sunday. Hollandale bids fair to become one of the finest Dutch Colonies in the United States.

North Carolina

Dr. Joseph Hyde Pratt, of Chapel Hill, North Carolina, charter member of the society, states that his reason for being interested in peat is, that, as Director of the North Carolina Geological and Economic Survey, whose work is the development of the natural resources of the State, he has investigated and studied the peat deposits of North Carolina and the uses of peat, and has tried to work out plans by which the extensive deposits of peat in this State could be utilized commercially. Believing that the peat industry in this country could and would be very materially assisted by a national organization, he assisted in 1907 in the organization of the American Peat Society at Jamestown, Virginia.

While, up to the present time the peat deposits of this State have not been commercially developed to any large extent, there has been a certain amount produced and used as a filler in the manufacture of fertilizers. A certain amount is composted and used locally as a fertilizer. Some of the areas have been tested for fuel purposes and in each case the peat briquette has tested out very satisfactorily. The construction of good roads and increased water and railway facilities are arousing a new interest in the peat deposits of North Carolina as a source of domestic fuel.

Canada

Mr. E. V. Moore, one of the society's active engineer members writes as follows:

"I expect the Government Peat Committee to be disbanded at the end of March, the Government being satisfied that the investigation has been successful and therefore does not require further Government support.

"I suspect the Peat Committee will promptly hand in their final report to the Government who will likely publish it with as little delay as possible, and, as I have told you be-

fore, I think this report will be a notable addition to the knowledge of peat fuel manufacturing now available in the English language.

"So far as I am concerned, as soon as I have this report off my hands, I intend to spend some of my time at least in an endeavor to interest private capital to start in where the Government left off. Since from the Peat Committee report it is evident peat fuel can be manufactured profitably in this country, and since the Government are willing to extend a certain amount of aid to assist private capital to get started, I do not anticipate having any difficulty."

PRICE OF BACK NUMBERS REDUCED.

An opportunity is extended to members to complete their sets of back numbers of the Journal of the American Peat Society at a price of 50 cents for each copy. The offer is for a limited length of time and only a relatively small number of copies is available. Send orders to Charles Knap, Secretary-Treasurer, American Peat Society, 2 Rector Street, New York, N. Y.

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is a discussion of the Ekenberg process as worked by the Swedish Government at Staffjö, and by the Wet Carbonizing, Ltd., at Drumfries, Scotland. A short summary of the recent work on peat fuel in the United States is followed by a description of the Jenkins Peat process and the Zwoyer Universal press as applied to peat. Peat charcoal is then discussed and a diagram given of the Ziegler Peat Coking ovens, erected at Beuerberg, Bavaria. The Schoening Fritz process, the Willmarth process for producing carbonized peat fuel, and the Hammerling process for making artificial wood blocks from peat are also described.

A short bibliography, a list of periodicals devoted to the subject of peat, and a short list of patents pertaining to the briquetting of peat close the entire chapter.

S. LINKER.

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U. S. PEAT PRODUCTION NEARLY DOUBLED*

By K. W. Cottrell
U. S. Geological Survey

The peat industry in the United States made substantial progress in 1922. Only three companies discontinued business during the year, and eight new ones entered the field. Three of these new companies produced a small quantity in 1922, and the others were preparing to operate in 1923.

The quantity of peat produced in the United States in 1922 increased nearly 100 per cent over that produced in 1921; the value increased 52 per cent. Peat used as fertilizer or as an ingredient of fertilizer increased 96 per cent in quantity and 47 per cent in value. Peat used as an ingredient of stock food increased in both quantity and value. The peat fuel reported for 1922 showed a considerable increase over the quantity and value reported for 1921. As there was a shortage of coal during the winter of 1922, more peat may have been utilized as household fuel than that here reported.

The 23 plants reporting production of peat in 1922 were distributed as follows: Michigan, 4; New York, 4; California, 3; New Jersey, 4; Illinois, 2; Massachusetts, 2; Florida, Maine, New Hampshire, and North Carolina, 1 each. New Jersey was the largest producer, with an output of 39,095 short tons, valued at $193,940; California ranked second, with an output of 10,988 short tons, valued at $115,943. Il-

[1] Statistics of imports and exports compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerc.

* Mineral Resources of U. S., 1922.

linois ranked third, but the State total may not be published, as there were only two producers.

The quantity of peat moss or litter imported from January 1 to September 21, 1922, according to the Bureau of Foreign and Domestic Commerce, was 3,394 tons, only 1 per cent less than in the whole year 1921. No exports of crude peat or peat products were reported for 1922.[1]

The consumption of peat and peat moss (production plus imports) was 64,074 tons, valued at $421,269, in 1922, against 33,856 tons, valued at $282,873, in 1921.

Peat produced in the United States, 1916-1922.

Year.	Number of plants reporting	Short tons.	Value.	
			Total.	Average
1916	13	52,506	$369,704	$7.03
1917	18	97,363	709,900	7.29
1918	25	107,461	1,047,243	9.76
1919	15	69,197	705,532	10.20
1920	18	73,204	921,732	12.59
1921	21	30,406	260 119	8.55
1922	23	60 689	397,729	6.55

Peat and peat moss used in the manufacture of peat products in the United States in 1921 *and* 1922.

Kind of product	Production.		Imports		Consumption.	
	Short tons	Value	Short tons	Value	Short tons	Value
1921.						
Fertilizer and fertilizer ingredient	29,460	$251,046	----------	----------	29,460	$251,046
Stock food	a 946	a 9,073	----------	----------	a 946	a 9,073
Fuel	(a)	(a)	----------	----------	(a)	(a)
Moss	(a)	(a)	3,450	$22,754	a3,450	a22,754
	30,406	260,119	3,450	22,754	33,856	282,873
1922.						
Fertilizer and fertilizer ingredient	57,747	369,165	----------	----------	57,747	369,165
Stock food	b 1,893	b 20,864	----------	----------	b 1,893	b 20,864
Fuel	1,040	7,700	----------	----------	1,040	7,700
Moss	(b)	(b)	3,394	23,540	b 3,394	b 23,540
	60,680	397,729	c 3,394	c 23,540	64,074	421,269

a Small productions of fuel, moss, and stable litter included under "Stock food."

b Small production of moss and stable litter included under "Stock food."

c Figures cover period, Jan. 1, to Sept. 21.

The following individuals and companies reported to the Geological Survey that they produced crude peat or peat products in the United States in 1922:

Alphano Humus Co., 2 Rector St., New York, N. Y.
Blaine, J. H., Hopewell Junction, N. Y.
Central Peat Corporation, Capac, Mich.
Chapman, I. S., & Co., (Inc.), 937 Third Street, San Bernardino, Cal.
Craig, William H., Fishkill, N. Y.
Day, James H., 35 South Street, Milford, N. H.
First Massachusetts Carbon Fuel Co., 306 Main St., Worcester, Mass.
Humus Natural Manure Co., 1964 Broadway, New York, N. Y.
Hyper-Humus Co., Newton, N. J.
McElhone, Asa, Fishkill, N. Y.
Manito Chemical Co., Peoria, Ill.
Marcrum, J. G., Netcong, N. J.
Morisite Process Corporation, First Nat'l Bank Bldg., Detroit, Mich.
National Humus & Chemical Co., Chassell, Mich.
Pacific Humus Co., 205 Central Building, Pasadena, Calif.
Peat Engineering Co., 189 Exchange Street, Bangor, Me.
Peat Products Corporation, 552 David Whitney Bldg., Detroit, Mich.
Phos-Pho Germ Manufacturing Corporation, New Bern, N. C.
Ranson, Robert, St. Augustine, Fla.
Riverside Orange Co. (Ltd.), Arlington Heights, Riverside, Calif.
Sims, Alfred F., Sag Harbor, N. Y.
Victory Fertilizer Co., 54 North Street, Boston, Mass.
Wiedmer Chemical Co., Pierce Building, St. Louis, Mo.

PEAT IN SOIL AMENDMENT [1]

By William Watson
Golf Course Architect

There has been considerable controversy in recent years as to the value of peat in soil amendment. Treated as a fertilizer, it has been universally condemned and as a soil builder it has had little credit, nor has it ever received fair consideration.

It is generally admitted that its fertilizing properties are negligible, but as a mechanical adjunct to the soil its value is inestimable and it cannot be overrated.

If the physical condition of the soil is not right, no amount of fertilization will be completely successful; on the other hand, in a well balanced soil comparatively little fertilization is necessary. All soils should be porous, allowing an easy inlet for air and water and they should also have a moisture retaining capacity.

With a plentiful supply of peat, sandy soils can be made more compact and they can be brought up to a normal water holding capacity. Clay soils are also benefited as they have a tendency to become too compact without the presence of a certain amount of organic matter.

The use of peat prevents extremes in soil temperature. A well balanced soil warms up more slowly and it also retains its heat for longer periods.

Peat alone cannot be classed as a fertilizer, but it puts the soil in a stable healthy condition and any fertilizer then applied will act with greater efficiency and less of it will be required to produce results.

In the growing of fine turf, some form of humus is essential, not merely as a fertilizing element, but more particularly to give the soil that loamy character necessary for the free development of the roots of the grasses. Peat is ideal

[1] From the County Club (Calif.) May, 1923.

for this purpose, its stability alone puts it at the head of all humus forming materials. The plants will fight for themselves, both for food and water if they are not cemented in by too compact soil. With an open soil, even without fertilizer, wonderful results can be obtained. Plant food does not come from the soil alone, a large proportion of it being derived from the atmosphere, but only then when the soil conditions are right.

It is not desirable in the growing of grass to prepare a heavily fertilized soil that will quickly exhaust itself. The surface of the ground would then soon grow irregular and the soil would eventually get into that hard-baked condition that makes it absolutely unfit for the growth of the tender plants.

A hard-baked soil increases evaporation, and the subsoil is soon robbed of all its moisture. A well prepared peat soil is not so easily warmed in the first place and evaporation from it it comparatively slow. This in itself is a most important point where irrigation expenses are considered. An overfertilized soil is a splendid breeding place for worms, grubs, etc., and many grass diseases could be prevented if peat were used instead of the ordinary organic fertilizer, as peat itself discourages the breeding of these animal pests. Moles and other grub hunting animals will not destroy peaty soils. They know they cannot find any grubs in such soil and it is therefore unmolested.

The chemical analysis of peat is no criterion of its value. Its real virtue is in adjusting the physical character of the soil and all growing soils require some adjustment.

SHORT SYSTEM OF PRODUCING PEAT[1]

By J. H. Van Glahn

A One-Unit Equipment Style No. B. Short System Peat Plant has a daily minimum working capacity of 900 tons of wet peat, extracts the moisture contents, and prepares the product for gasification and other purposes.

I have always advocated and still maintain that if correctly started with the right kind of machinery properly installed peat products can be made at a low cost of production.

With this object in view I have labored and experimented for a number of years to perfect a short system of producing peat products which in every way is original and modern, designed to meet the present day requirements.

The short system of production consists of a mechanically constructed water extractor, drainage vats, gas producer, and minor appliances.

For excavating peat in wet bogs a 2¼ yard clam shell bucket excavating device is used, having a minimum working capacity of two buckets per minute in twenty feet of water, discharging 90 tons of wet peat into transfer cars located on flat boats.

Drainage vats are provided which form part of the water extractor in which the wet peat is deposited as it comes from the bog. The drainage vats are 146 feet in length, 8 feet wide and three feet deep. When charged with peat 26 inches in depth they have a storage capacity of 90 tons each. The drainage vats are charged and recharged once every hour,

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[1] Mr. Van Glahn's address is 2225 Rosewood Avenue, Toledo, Ohio.

The society takes no responsibility for the statements in this paper and the editor does not concur in them.

Mr. E. V. Moore, fuel engineer, and contributing assistant editor, states that, according to the information which has been collected by the Peat Committee of the Canadian Government and their experience, Mr. VanGlahn's claims for his drainage vats con not be realized in any sense. Mr. Moore's experience goes to show that instead of reducing the water content to 25 per cent in one hour it would probably take two or three months if peat were spread 26 inches deep.

having a minimum working capacity for handling 900 tons of wet peat per day.

The water extractor is a specially designed feature for removing water from peat. It consists of a drainage vat underlined with fine gravel, over which is placed coarse burlap fabric securely held in place with perforated sheet metal with properly leveled surface, and a mechanically-operated roller 9 feet in diameter made of boiler iron. The roller revolves at about 6 revolutions per minute, is suspended and supported by means of a steel frame in connection with a movable carriage, which allows the roller to operate on the product in the drainage vats with or without pressure. The roller travels at intervals back and forth the entire length of drainage vats kneading. destroying the fibers, compressing and condensing the product to about one-third its original volume, reducing the moisture contents down to about 25 per cent and preparing the product for gasification. For convenience and economy the water extractor is operated by electric power.

After the peat is properly treated, prepared and finished the product is then cut into strips of suitable width the entire length of drainage vats by means of circular saws attached to and operated in connection with water extractor. This operation is followed up by cutting the strips into blocks by means of an automatic mechanical peat cutter and oscillatory shovel which removes the peat blocks to a platform outside the drainage vats.

Charging the drainage vats is accomplished by conveying the transfer cars containing wet peat directly over a drainage vat and dumping the contents from the bottom of each car.

By the use of the short system of producing peat products, all pulleys, belting, shafting, elevators, conveyors, pug mills, peat presses and hot air driers are eliminated from the peat plant, and the entire product of the plant is treated and prepared on the ground floor.

The closed horizontal gas producer, a specially designed feature, is substantially constructed and internally lined with moulded baked fire clay blocks, made to resist intense heat, is self contained, and internally fired at a uniform tempera-

ture throughout. The firing is done at both sides of the producer, which allows the fire to come in close range with the product and a much higher temperature can thus be obtained, which enables one to make much harder fuel and more rich gas.

The gases driven off in the process of coking pass out of the producer at the top into a main.

The gas producer is provided with tight closing doors at each end, such as are commonly used in sand lime brick kilns, and are easily adjusted.

The peat blocks prepared for gasification are placed on tram cars and conveyed into the gas producer. When charged the doors are closed and the gas producer fired to about 3,000 degrees F. In about two and one-half hours the peat is fully coked, the cars and contents are then withdrawn from the gas producer and dumped, and the gas producer is immediately recharged without cooling. Two gas producers are required with a working capacity equal to the water extractor.

Nine hundred tons of wet peat taken from the bog in one day and treated by the short system of production will yield approximately 45 tons of soft coke equal in quality to charcoal, 9,360,000 cubic feet of gas containing heat units equivalent to soft coal producer gas; if converted into fertilizer the wet peat will yield about 117 tons of dry product, if a good grade of peat is used.

It requires 25 common laborers and one superintendent to operate a one-unit short system No. B. Peat Plant ten hours to handle, prepare, and gasify the product obtained from 900 tons of wet peat, including excavation.

Labor at 55 cents an hour and superintendent's salary included amounts to about $147.00 per day.

Approximately 936,000 cubic feet of gas for fuel is consumed to drive off the gas from the 117 tons of dry peat obtained from 900 tons of wet peat excavated and taken from the bog. About five tons of peat coke is required in ten hours to operate the excavating device, and generate electricity for a small power plant necessary to operate the complete peat plant, including moving of transfer and tram cars.

Deducting the gas and coke fuel required to operate the peat plant and excavating device from the amount produced should leave a surplus of 8,424,000 cubic feet of gas valued at 14 cents per thousand, or $1179, and 40 tons of peat coke valued $20 per ton or $800.00, a total of $1979. If the labor account, overhead expense, and interest on an investment about $175.00 be deducted it should leave a fair margin of approximately $1,800, the profit to be derived from the products obtained by treating 900 tons of wet peat in one day.

Gas resulting from the destructive distillation of peat in closed gas producers contains considerable oils, nitrogen and tarry substances which can be distilled for various purposes an additional profit. A good quality of peat should yield about 200 pounds of ammonium sulphate per ton of dry product valued at $4.00 per hundred, or $79 in ton lots.

A one-unit equipment short system style No. C. Peat Plant has a working capacity for handling 1,500 tons of wet peat in ten hours, including excavating peat from bog.

The short system of producing peat products is designed for the purpose of increasing the working capacity and production of a peat plant, to simplify operation and to save labor and operating expenses. The working mechanism of this device has been fully tested out and proved satisfactory, and the system of production will meet the present day requirements, as an investment and financial success.

CONTRIBUTION OF PEAT INVESTIGATIONS TO THE CRANBERRY GROWER *

By A. P. Dachnowski
U. S. Department of Agriculture

The full meaning and point of view of such a contribution can be made best only on the basis of a clear understanding of what constitutes peat investigations.

In the early work of peat studies in this country as well as in Europe, there was no recognition of more than two distinctions in peat material: peat and muck; highmoors and lowmoors; high lime peat and low lime peat. As the study of peat deposits in their field condition proceeded, and especially as the accumulation of knowledge increased, without reference to the particular use to be made of the information gained from careful peat investigations, certain features of construction became evident. In 1917, observations (1) regarding the structure of Massachusetts peat deposits were presented which, for the first time, indicated the importance of stratigraphic peat investigations for that state. The question now asked is: What form are the peat investigations taking today?

I.

It will be sufficient for the present purpose to state that peat investigations of today are continuing the stratigraphic study of peat deposits themselves, in their natural environment. The work is concerned primarily with the determination of the number and character of the units or layers of which peat deposits are constructed, and with the position and arrangement of the various units or layers. The recog-

[1] Dachnowski, A. P., 1917. The formation and characteristics of Massachusetts peat lands and some of their uses. In Trans. Mass. Hort. Soc., 1917, pt. 1, p. 29-45. Reprinted in Jour. Amer. Peat Soc., v. 11, no. 2, p. 58-72 1918.

* Presented to the Cape Cod Cranberry Growers Association at Wareham, Mass., April 20, 1923. Published with the permission of the Secretary of the U. S. Department of Agriculture.

nition of the existence of different types of peat and of their relative importance was brought about by the field work with the present methods of peat investigations.

That units or layers of peat material exist, and that they can be identified by the plant remains of the different groups of vegetation from which they are derived is no longer questioned. The separation of peat into different types of organic material was necessary, because field observation showed that the differences in botanical composition and physical characteristics were wide and important. The first step on which the differentiation of peat deposits was begun in this country was therefore, U. S. Bulletin 802. It describes the various characteristics of the several units of peat material and indicates in more or less detail their relative importance for crops and other purposes. The main facts of the physical appearance of these peat units or layers are summarized in the following table.

Structural Units of Peat deposits and some of their physical characterisstics

Table 1.

Groups of Peat Forming Vegetation	Types of Peat	Character of Peat Layers	Color of Peat Layers	Texture of Peat Layers	Structure of Peat Layers
Aquatic	Macerated Colloidal	Pulpy	Olive green,, brown to black.	Coarse to very finely divided	Compact, impervious, stiff, plastic or loose, friable.
Marsh	Reed Sedge Brown Moss	Fibrous	Gray, red, or yellow-brown to dark brown.	Coarse to fine fibered.	Dense, matted, felty, or porous, spongy
Bog	Bog Moss Heath Shrub				
Swamp	Willow-Alder Shrub Deciduous Forest Coniferous Forest	Woody	Dark brown to blackish brown.	Coarsely fragmented to granular.	Compact, granular, or loose, wicker-like.

II.

This condition of affairs in peat investigations did not continue long. Through field observations which extended over a wide area of this country and included a great many different kinds of peat deposits, it soon became evident that peat deposits possess unique characteristics of their own. A

fundamental difference between peat deposits was that of the complexity of their structure, and of their relative age. As an illustration of the structural complexity on which the differentiation of peat deposits is based the following profile sections (Fig. 1 and 2, and table 2) should be examined. The profile sections shown in Fig. 1 and 2 were obtained from a recent economic survey in Charlevoix County, Michigan, with the co-operation of the U. S. Bureau of Plant Industry. The most striking feature which they establish is the two-fold division into the group of water-laid and the group of land-laid peat deposits. The former indicate lakes, ponds, and other basins of water as the field conditions under which layers of peat accumulated. The other group points to moist, flat land areas, more or less poorly drained. The presence of roots in the mineral soil indicates that the water level rose with the accumulation of peat; it practically maintained itself over the area of active peat formation in close adjustment to climatic conditions and to the growth of the vegetation which held back the natural drainage. Land-laid peat deposits exhibit much more clearly the past conditions of the local environment by which the character, number, and position of the various layers were brought about. Peat deposits of that kind can be drained and aerated to the bottom and rarely need the more elaborate drainage measures which are required for water laid peat deposits, or those subjected to overflow from river inundation. The importance of this difference in peat deposits to the cranberry grower will become obvious later.

It is now also recognized that peat deposits are the products of glacial and climatic forces that were operative when the peat materials began to accumulate. When important differences in profile sections exist they are expressions of corresponding differences in the past vegetation, and geological or climatic history of the region. The same profile sections with slight variations have been found in many parts of the eastern and central part of the United States, which belong to a common glacial belt. As the glaciers receded from their greatest southward extension about 30,000 years ago, the peat deposit at Canton, Ohio, was among the first

Table 2.

Stratigraphic Features of Peat Deposits in the United States

	I	II	III	IV	V	VI	VII	VIII	IX	X
Glacial Sub-Stages	Canton, Ohio	Kent, Ohio	Kankakee Ind.	Dismal Swamp Va.	Everglades Fla.	Mantua, Ohio	Fredmont Ind.	Sanilac, Mich.	Rome, N. Y.	Chassel, Mich.
8. Present	Sedge	Forest + Sphagnum	Forest + Macerated	Forest + Macerated	Sedge + Macerated	Forest	Sedge + Macerated	Shrub Sedge	Forest + Sedge	Forest + Sphagnum Sedge
7. Recent	?	Sedge	Sedge-Reed	Forest	Sedge	Forest	Colloidal	Forest	Forest	Forest
6. Port Huron	Sedge + Hypnum	Macerated	Forest Macerated	+ Macerated	+ Macerated		+ Macerated	Sedge	Hypnum	
morainic system								Macerated		
5. Lake Border	Sedge + Hypnum	Forest Sedge	Shrub + Sedge Sedge	Forest + Macerated	Sedge + Macerated	Forest Sedge	Colloidal + Macerated Sand			
morainic system						Macerated	Macerated			
4. Valparaiso	Reed Macerated Clay	Forest Sedge Macerated	Forest	Forest	Sedge					
Kalamazoo morainic system	Macerated									
3. Bloomington										
2. Shelby										
1. Wisconsin drift										

Schematic presentation of peat deposits to show that differences in structural complexity indicate differences in relative age or length of time since accumulations of peat began, and that peat deposits are climatic and vegetation records of the past history of the country. (From the author's paper "The Correlation of time units and climatic changes in peat deposits of the United States and Europe" in Proc. Nat. Acad. Sci., v. 8, p. 225-231, 1922. Literature cited p. 230-231).

to became established. It is in the region of the Bloomington morainic belt and has a profile as shown in Table 2. In close proximity (near Kent, Ohio) may be found a peat deposit belonging to a later glacial sub-stage. The profile of this deposit of peat is shown graphically in the second column of Table 2. At about the same time, from a glacial history viewpoint, a remnant of a former wide-spread shallow lake had drained away near South Bend, Indiana. The profile section of this peat deposit is in the third column of Table 2. Even for a short discussion it would require more space than can be given in this paper, to take up a comparison of the profile sections of peat deposits in Virginia, Florida, Michigan and New York, or to show certain correlations between peat deposits in this country with those of the continent of Europe. But it can be readily seen that the relationships are such as to point strongly to a difference in the age of these deposits. The explanation of the stratigraphic or structural differences between peat deposits in the United States and Europe is in the fact that they are records of a common history of past glacial, climatic, and vegetation changes. These profile sections signify therefore differences in the length of time since peat accumulation began; and they are no less conclusive evidence that geological and climatic as well as biological forces have determined the number, character, thickness, and arrangement of the various layers in a peat deposit.

A great many peat deposits have been encountered where important structural differences exist, correlated not with glacial geology, but with the influence of weathering forces and local fluctuations in water level. In the eastern United States the climate is of such a character that lime and other soluble mineral salts are easily attacked by weathering agencies. It is a region in which a progressive leaching of dissolved organic and mineral substance is going on. In some localities the area of deposition or accumulation of certain salts may be either at the margin, as in the case of bog iron, or it may take place at some depth below the surface, as a hardpan. In other localities, and more especially in the western states, the operation of the weathering forces, to which drained peat deposits are subjected, leads less to leach-

ing but much more to disintegration of the peat material and to an accumulation of lime and various other salts at the surface. Such soluble mineral substance as are derived from the water supply, or exist in the mineral subsoil, are in process of more or less rapid concentration near or on the surface layer of peat; they form an excess of soluble salts which in many cases reacts injuriously upon the roots of crops. These conditions point to the conclusion that the dark color, the degree of disintregration, the high lime content, and the presence of moderate amounts of phosphates in some of the western peat deposits are features not of climate, or of age, but of local soil conditions and stronger weathering influences. However, even these exceptions can not be regarded as differences which should be emphasized. All the knowledge gained by indirect study of peat deposits, whether through the study of the native vegetation, chemical analysis of fertilizer constituents and acidity, or through the interest in topography, or economic problems, has a suggestive value, but in itself any one of these viewpoints does not give the information that is fundamental and constructive in peat investigations. Peat deposits must be observed more systematically in their construction, and selected after a thorough study of the local topography and all other conditions; just as special bridges for example, are studied and selected for their material, construction, and application to the practical purposes, or in order to replace the structures that for a long time had been objectionable, costly, and troublesome to maintain. On that account, it seems advisable that the states containing peat land should take up their own studies of the peculiarities of the individual local peat deposits. Effort along that line should be given every assistance and all the weight it deserves, since peat land resources constitute one of the present and prospective means to increase the requirements in these states for crops, pastures, and re-forestation, or wild-life reservations.

III

There is a third contribution which the present method of peat investigation makes possible. It will become more important in the near future. Not only does the work as

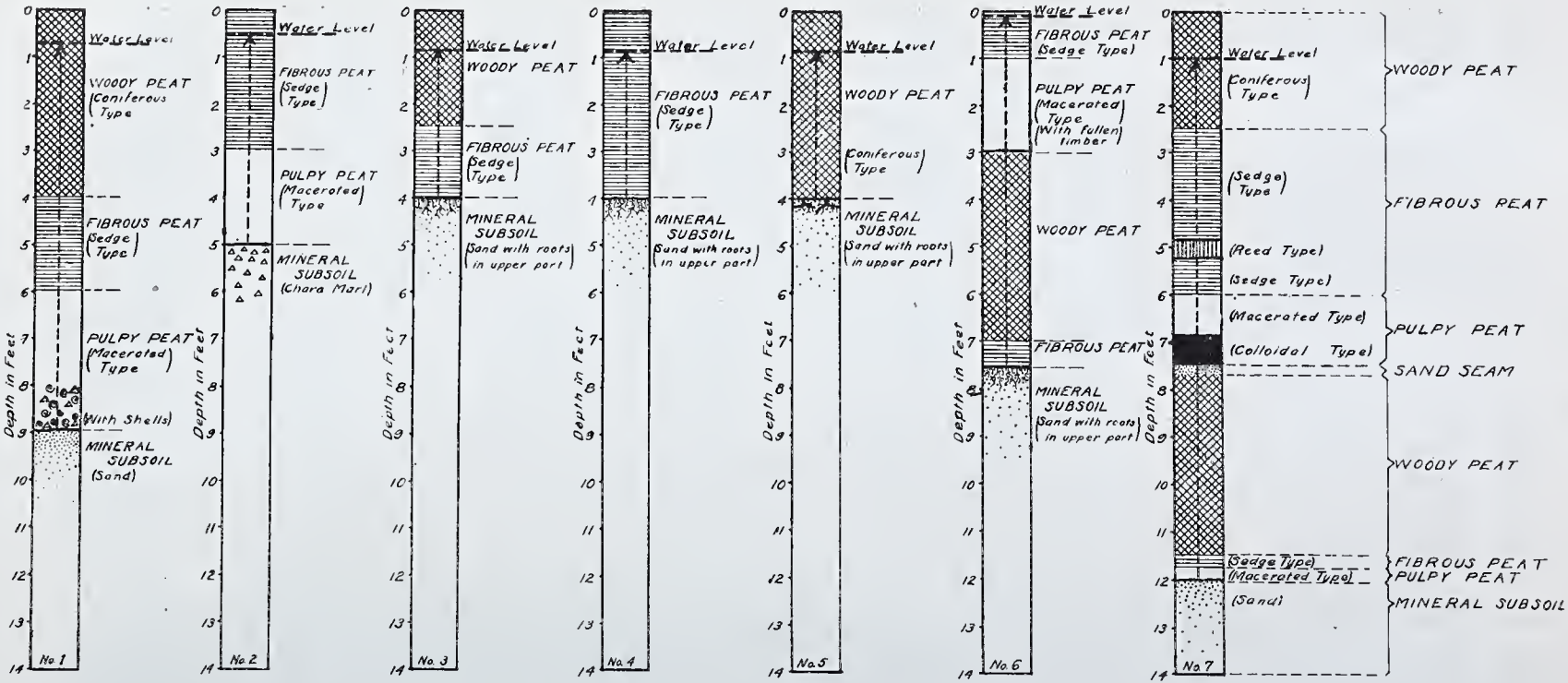

Fig. 1. Graphic presentation of profile section of peat deposits in Charlevoix County, Michigan, to show the character, thickness. and arrangement of layers of peat in water-laid and in land-laid peat deposits. (Courtesy Michigan Land Economic Survey in cooperation with U. S. Bureau of Plant Industry).

now carried on define peat deposits on the basis of the units of peat layers and profile sections as they exist in nature but in so far as laboratory studies are concerned, a determination is made on the same basis of the physical, chemical, and bacteriological constants of the various layers of peat. The same will be true of pot experiments, and it is hoped, also of experiments carried out in the field. In the past, studies of this kind have been made without regard to the actual composition of the organic material or position of the peat layer. For comparative scientific, and practical economic purposes there is no significance to the analytical results obtained from samples of peat which have been secured in the field indiscriminately. They do not throw any light on peat deposits in their field conditions, and they cannot be used as a basis for consistent peat investigations or as an aid to intelligent recommendations for improvements or for the introduction of new crops.

Among the main physical studies on the differences in layers of peat are volume-weight, porosity, and colloid content. Both the movement and the amount of air, water, and salts from the mineral sub-soil are controlled by differences in these characteristics; the physical properties of a peat material have a marked effect upon the absorption and conduction of heat and gases, and they may increase or reduce the growth and development of microorganisms and the nutritive conditions of the root system of crops. A knowledge of the physical characteristics of peat layers is essential in order to make cultural methods more remunerative.

Besides the physical differences there are important chemical contrasts. Peat layers consist of organic chemical substances such as nitrogenous compounds, lignin, cellulose and other carbohydrates, waxes, resins and similar plant products. The plant remains furnish just that amount of organic compounds and of energy which was constructed and transformed from the light of the sun by the vegetation forming the peat material of that time. A great many of these substances may be utilized either directly or indirectly by fungi and bacteria as a source of food. Under abnormal conditions, such as are brought about today by flooding, by a

cover of sand, or by adverse methods of drainage, or cropping, the incomplete decay of the organic products may cause serious reactions on crops. For the purpose of obtaining accurate data on organic decomposition products at least a

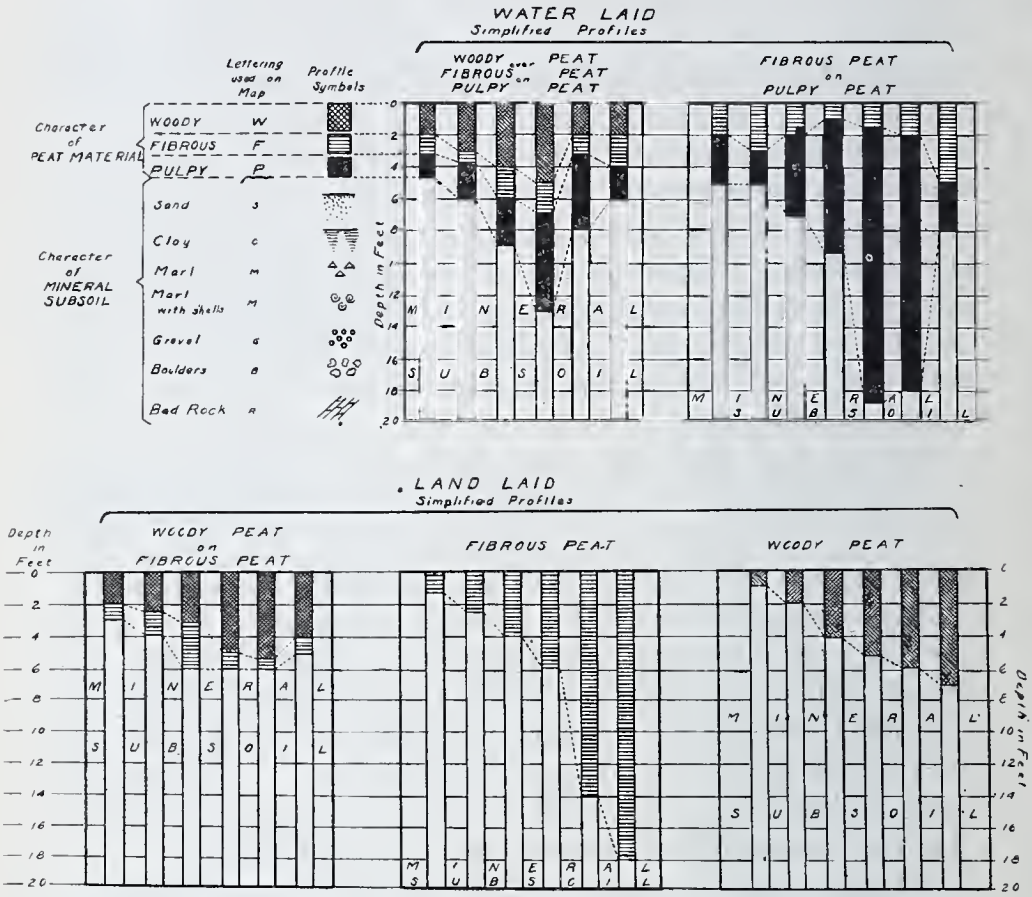

Fig. 2. Profile sections of Michigan Peat Deposits, illustrating structural features and some of the various types of peat on which the stratigraphic system of classifying peat deposits is based. (Courtesy Michigan Land Economic Survey in cooperation with the U. S. Bureau of Plant Industry).

few preliminary chemical investigations are necessary to show the differences in composition of peat layers in regard to nitrogenous compounds, carbohydrates, ether- and alcohol-soluble compounds.

There are various kinds of microorganisms which react upon the organic substances referred to above. They produce chemical changes of which many may be highly detri-

mental to crops when aeration is lacking. Water-laid peat deposits in particular, with a cover of sand or flooded for any length of time, appear to exhibit more or less rapidly conditions that favor reduction processes. The bacterial population and their products resemble those of stagnant water bodies. Almost nothing is known as yet concerning the chemistry and bacteriology of sanded or flooded peat deposits. Much depends on stratification and on the botanical composition of the peat layers; much is doubtless the result of the kind of microorganisms active or perhaps due to some sort of relationship in which various groups of bacteria and fungi carry out the successive stages of decomposition. The changes which may be noted in sand covered or flooded water-laid peat deposits are the reduction of sulphates and possibly of phosphates, and those other changes which are characterized by the withdrawal of oxygen not only from the water but also from the carbohydrates and nitrogenous substances of the organic materials. The very marked darker color which is taken on by peat samples secured at various depths below the surface, and the production of sulphuretted hydrogen, methane or marsh gas, indicate in a measure reduction processes. It appears quite probable that they inhibit the activities of many beneficial mycorrhizal fungi and bacteria, and in this way further prevent a normal decomposition of peat layers and consequently a normal functioning of crops.

Not only is it important therefore to know in what relations to one another layers of peat exist in peat deposits used for cranberry culture, or for other crops, but it is equally significant to know what kind of a structural combination of peat layers can be regarded as the best selection for the growing of cranberries, or for other uses. In that direction, the identification and description of peat layers and the recognition of structural differences in peat deposits on the basis of number, character, thickness and arrangement of the layers constitutes no doubt, one of the most important contributions that has been made in the field of peat investigations. It supplies the long needed rational basis for the comparative study of such peat deposits which give high or low crop yields, and it serves for the correlation of the respective laboratory

studies. When applied to field experiments it will aid in determining what structural features of peat deposits and which layers of peat material have a slight or a profound effect on crops and on plant diseases.

NEWS OF THE INDUSTRY

Peat As Fertilizer Ingredient

The following article appeared in the December 6, 1922, edition of the Official Record of the Department of Agriculture. In presenting it the editor wishes it understood that the statements made in the discussion are not concurred in by himself, by many students of peat in private life, nor, as shown by the two succeeding expressions, by other organizations and individuals of the U. S. Government.

FERTILIZER COUNCIL DECIDES THAT PEAT HAS LOW VALUE

"That peat has a low fertilizer value, is the opinion of the department council, which has been studying the problem as a result of many inquiries. During the past few years peat has frequently been advertised for sale as "humus", to be used as fertilizer or in place of fertilizer or manure. It has been alleged that special processes, such as "bacterization," occasionally gives it unusual power to improve soil conditions and in plant growth. The department council finds that peat, as well as muck and similar materials, whether bacterized or not, are distinctly inferior to stable manure or mineral fertilizers for increasing crop production. Although it is too bulky and too poor in available plant food to serve as substitutes for these materials, certain kinds of peat appear to be suitable in the growing of specialties or as a potting soil in greenhouse forcing. In the manufacture of mixed fertilizers the use of peat as a conditioner, as well as a filler appears to have been satisactory to the mixer.

"According to the statement made by the department council, a well decomposed layer of peat contains little plant food of any kind. The rather high percentage of nitrogen occasionally found in peat or muck is due not to the presence of available nitrogen but to the slow accumulations of nitrogenous material of an extremely inert character, the more soluble substances having been lost. Peat deposits represent

slow accumulations of layers of plant material of different kinds, and show great variation in texture and quality. Many peat deposits are agriculturally unsatisfactory and some peat contains substances which actually injure plants. However, considerable areas of peat and muck soils are under cultivation and these frequently show high productivity for many kinds of truck crops or as grass land.

"The claims of unusual value for bacterized peat appear to be based more or less directly on statements made a few years ago by Professor Bottemley, of England. Further experiments in this country and abroad have failed to support this theory and no laboratory process for the "bacterization" of peat which improves its fertilizer value has been discovered."

Views of the Bureau of Soils

"Dr. C. C. Osbon,
Editor, Journal of American Peat Society,
Box 1173
Ponca City, Oklahoma.

My dear Dr. Osbon:

This is in reply to your request of the 18th for a statement of why we have an interest in peat.

The activities of this Bureau have at least three points of contact with peat products.

Peat or muck soils are constantly being encountered by the Soil Survey, and they constitute an important division of soil types.

Dried and ground peat is being used successfully as a filler, or conditioner, in commercial mixtures; and we anticipate an increase in this use of peat.

As an absorbent litter in stables and stock barns, dried peat is attracting increasing, favorable attention; and according to a recent Consular Report, fresh machine peat has proven an excellent humus—rich "base" in admixture with sewage sludge, of value in the agricultural reclamation of sandy waste land.

With best wishes for the welfare of your valuable publication, I remain,

Very truly yours,

MILTON WHITNEY,

Chief, Bureau of Soils."

POSITION OF THE U. S. GEOLOGICAL SURVEY

The United States contains 12,000 square miles of unused peat and muck land, an area more than ten times that of Rhode Island, according to a comprehensive bulletin issued by the United States Geological Survey. The deposits are on the surface. They lie in New England, Atlantic and Pacific Coast, and Great Lakes States.

This bulletin, the most exhaustive American work on peat, required two years for preparation. It points out the location of thousands of deposits, owned by thousands of farmers and other land owners.

Peat is suitable for use as a fertilizer and in promoting the intensive growth of truck and other crops, both in greenhouses and in open fields.

Manufacturers of commercial fertilizers pay $10.00 a ton for good peat. The present output is about 100,000 tons annually. In some parts of the country, yearly proceeds from intensive cultivation of peat and muck soil amount to more than $500.00 an acre.

Those who own or are interested in deposits of peat or muck may obtain free copies of the bulletin by addressing the United States Geological Survey, Washington, D. C. It was prepared by C. C. Osborn and E. K. Soper and is published as the U. S. Geological Survey's Bulletin 728, entitled, "The Occurrence and Uses of Peat in the United States."

Phosphorus A Good Investment On Some Peat Soils

Peat soils are commonly thought of as being deficient in potash. There are, however, large areas of peat in Minnesota that show the most striking response to phosphorus, and sometimes both phosphorus and potassium are needed. Emil Hallgren, of Kittson County, Minn., writing in the Northwest Farmstead, tells of an interesting experience with fertilizer on peat, in which phosphorus increased the yield of oats over five times, and even doubled the yield over manure.

"A few years ago," he says, "we tried an experiment on some peat soil with acid phosphate, 0-16-0. We have a half-acre plot, on which we applied 200 pounds of phosphate, and alongside this plot we had a half-acre on which we applied seven tons of manure, with an unfertilized plot between. These plots were seeded to oats. We did not thresh these separately, but the weights of straw and all figured on an acre basis are as follows:

Phosphate plot	13,824 pounds per acre
Manured plot	6,528 pounds per acre
Unfertilized plot	2,432 pounds per acre

"The next year we had hay on these plots seeded with oats, and it also showed the same proportionate yields, though no fertilizer had been added."—Bulletin American Fertilizer Association, April, 1923.

Washington Argues Age Of Old Swamp

Fossil diatoms, microscopic plants which lived some quarter of a million years ago, and oldest inhabitants of this city who admitted to an age of less than 80 years were called as witnesses in a recent joint meeting of several scientific societies to determine the age of a subterranean cypress swamp unearthed in Washington through excavations for a new hotel. Geologists, biologists, and physiographers all appealed to scientific evidence to prove the swamp to be of the Pleistocene period, and were not disconcerted when a white-haired resi-

dent of the city asserted that while he could not date back 250,000 years, he had been swimming in the swamp.

The swamp relics, consisting of the stumps of huge bald cypress trees, and leaves and seeds imbedded in a black muck, were found at a level of about 16 feet below the surface and extending from 6 to 9 feet deeper. Few tree trunks were found. The muck soil contained many cypress leaves and seeds, as well as seeds of the grape, elderberry, blackberry, and several varieties of sedges, also many diatoms.

These diatoms, according to Dr. Albert Mann of the Carnegie Institution, furnished one of the strongest evidences for the antiquity of the swamp for they were declared to be utterly unlike the diatoms which are now native to the District of Columbia. They closely resembled others found in ancient swamps near Montgomery, Ala., Crane Pond, Mass., and in parts of Africa and British Guiana, all of which have been identified as of Pleistocene origin.

Dr. Frederick V. Coville of the Department of Agriculture and Prof. E. W. Berry of Johns Hopkins University agreed that from a botanical standpoint the relics showed the climate of Washington to have been milder than at present and that they were of undoubtedly great antiquity. Dr. Laurence LaForge of the Geological Survey declared that from a physiographic standpoint the age of the swamp must have been at least that of the latest or "Wisconsin" ice age, or from 100,000 to 200,000 years.

The meeting then being thrown open to discussion one of the "Oldest Inhabitants" arose and said that he had been swimming in the swamp with hundreds of Civil War soldiers and government employees during that period. He accounted for the depth of it by fills which had been made by the District government subsequently. Dr. C. L. Marlatt of the Department of Agriculture also stated that there was good evidence for the belief that a swamp existed near the disputed site within the memory of living men.

In rebuttal, Dr. LaForge said it was well-known that a small stream used to flow near the site of the disputed swamp and that undoubtedly the older generation of Washingtonians had bathed in its waters but that it was not exactly on the old

swamp site and was at a higher elevation. When he asked any of the "Oldest Inhabitants" present who remembered seeing cypress trees growing in the swamp of their boyhood to stand up there was no reply.

The testimony seemed to indicate that while there was a swamp near the site of the one in question within recent times, it contained no cypress trees and that the one uncovered was of ancient origin, probably dating back to early Pleistocene time.—Science News Letter.

New Jersey

Trenton, June 18.—A total of 39,095 tons of peat were mined in New Jersey and sold as fertilizer during the year 1922, according to figures compiled by the United States Geological Survey and the State Department of Conservation and Develompent. The substance was obtained from the peat deposits of northern New Jersey, chiefly from the Pequest River in the Great Meadow section in Morris County. The material had a total value of $193,940.—Jersey City Journal, June 18, 1923.

NEWS OF THE SOCIETY.

Massachusetts

Mr. H. J. Wheeler, of Boston, Massachusetts, states that he is interested in the utilization of peat on account of the high cost of coal in New England. He says that they have not been able to get enough to supply their needs. He is the owner of a considerable peat area in eastern Massachusetts.

Minnesota.

The James Jerome Hill Reference Library, of St. Paul, is a reference and research library, founded by the late James J. Hill and endowed by his family. Mr. Hill, in his lifetime, took the greatest interest in the commercial importance of peat and its products. He sent a man to Germany to study the commercial value of peat and its by-products as treated by German producers. He urged many times upon the people of Minnesota the value of the state's peat deposits and the importance of turning them to practical uses.

This state has extensive deposits of peat. Very little has been done as yet toward utilizing them. We all hope and believe that this will come in the near future.

Mr. H. W. Richardson, Secretary of the Duluth Chamber of Commerce writes that for many years he has been considerably interested in the subject of peat, and has accumulated much information regarding that subject in respect to his section, where there are enormous deposits of this material. The Duluth Chamber of Commerce is showing interest in the subject, and he feels certain local interest of a constructive nature will likely receive a very gratifying stimulus on the publicity he can give to Geological Survey Bulletin 728.

New York

Mr. H. A. Huston, of New York, is a student of peat land cultivation. He became interested in peat over 30 years ago. At the time there were large areas of peat land in Indiana, which in a short time after being brought under cultivation, became unproductive. The owners of this land applied to the Indiana Experiment Station (with which he was then connected) for help, and they worked out then the fact that these lands were very deficient in potash, and that the use of from 100 to 200 pounds of muriate of potash per acre would make these soils produce from 50 to 60 bushels of corn per acre, even when the water level was only 13 inches below the top of the ground. This discovery gave the owners of peat lands confidence in the land, and they were willing to go to the necessary expense to drain it properly, and large areas which were formerly unproductive swamps have now been brought under cultivation.

Illinois

The following very interesting letter was recently received from Mr. Frank C. Souhrada, of Forrest Park.

"In 1918 we had a very dry summer, so dry that a spark, dropping from a passing train, set fire to the peat in our marsh on August 20, and the fire continued until put out by several rain storms on September 21.

"The following winter started early in October, and fuel was very hard to get. The suffering of Europe through want of fuel added to our fright. In placing an order for the limited one-half ton of real cheap bituminous coal at the price of anthracite, I wondered how we could manage to keep children protected from cold weather in case of real distressing conditions such as existed in Europe.

"My mind went back to that thirty-day fire in the marsh, and it occurred to me that if the muck would burn in the field, it would in a stove. The following week end I tested the peat I had piled up for fertilizing purposes. I selected a

few scuttles full of the dried clods, and putting them in the Oak Heater, found that they gave a real hot fire.

"Discovering the fuel value of the marsh, I communicated the thought to neighbors owning peat fields, and then devoted time in running down the subject in the libraries, only to find that my 'new discovery' was centuries old and highly developed in Europe, and that peat was an asset of our country that some day, possibly in the near future, would be used.

"For that reason I have become, and intend to remain a close student of peat and to co-operate with all earnest minded persons in the full development of this great national resource."

CONVENTION FOR 1923

The Executive Committee has not yet reached a decision as to the place or date for the 1923 convention. Florida is looked upon with favor because no meeting has been held in that district for many years. It is the feeling of the committee that the meeting should be held this year in a place where there is much local interest, and an attempt is now being made to ascertain the extent of the interest in several places. It seems reasonably certain that the convention will be held somewhere in the South at a date somewhat later in the year than has been customary. This would be desirable because of more favorable weather conditions in early winter than in the early fall in that part of the country. Wherever the convention is held this year, it will be held after the hot weather, probably in November or December, and possibly in Florida. The place and date will be announced in the October number of the journal.

Price Of Back Numbers Reduced.

An opportunity is extended to members to complete their sets of back numbers of the Journal of the American Peat Society at a price of 50 cents for each copy. This is 30 per cent of the cost of printing. The offer is for a limited length of time and only a relatively small number of copies is available. Send orders to Charles Knap, Secretary-Treasurer, American Peat Society, 2 Rector Street, New York, N. Y.

The Toledo Type-Setting Company announces the death of E. J. Tippett, Secretary, Treasurer and General Manager, on May 12, 1923.

This company has been printing the Journal almost since the date of the society's organization. Mr. E. J. Tippett, Jr., has succeeded to active management of the company.

New Members

The following new members have been enrolled by the secretary since the April Journal was published.

J. H. Van Glahn,
2225 Rosewood Ave.,
Toledo, Ohio.

Richard Whitney,
14 Wall Street,
New York, N. Y.

Geo. D. Williams,
1248 Donald Ave.,
Cleveland, Ohio.

J. M. Harrison,
8 Ivy Street,
Atlanta, Ga.

Journal of the
American Peat Society

VOL. XVI. OCTOBER, 1923. NO. 4

SEVENTEENTH ANNUAL CONVENTION

The 17th Annual Convention of the American Peat Society will be held in Washington, D. C., on December 6, 7, and 8, 1923. It was stated in the last journal that Florida was under consideration for the next meeting, but there did not appear to be sufficient local interest and it seemed that excessive rainfall would prevent field excursions in the Everglades.

Professor James H. Beattie, Horticulturist of the Bureau of Plant Industry, has taken charge of the program, and an interesting 3-day session is therefore assured. The peat specialists of the Department of Agriculture and some of the members of the Department of the Interior will participate. Subjects that will be treated in papers are the use of peat and muck soils for crop production, peat as a source of organic matter for inoculation and fertilizer, and the industrial phases of other branches of the industry. Persons who attend the convention will be given an opportunity to inspect the experimental plats of the Department of Agriculture. The meeting should be the most instructive in the history of the Society, and all members are urged to attend. A tentative program will be mailed at an early date to members.

BOG SHOES

By John T. Stewart
Consulting Engineer
Drainage and Wet Land Development, 2223 Knapp St., St. Paul, Minn.

The statement is often made that it is not practical to cultivate peat or muck lands after heavy rains, due to the fact that they will not support the weight of horses.

The horse is intended by nature to work on solid ground, as the area of the hoofs is small in comparison with the weight to be supported. Consequently when a horse steps on soft material, or a soil that is thoroughly saturated with water, there is a tendency for the material to flow out from under the hoof and permit the hoof and leg to sink. This condition renders it very difficult for the horse to move, and the sinking may continue to such a depth and at such a rapid rate that motion ahead by the horse is impossible.

The average horse under such conditions usually becomes excited, plunges around, and sinks deeper into the yielding material. A horse accustomed to work on these soft materials, when he finds he is sinking, will lie down and partially roll over. The lying down distributes the weight over a large area and prevents further sinking, while the rolling onto the side permits the feet to be extracted from the soft material. Consequently, when it is found that a horse is miring, which is the ordinary way of expressing the fact that he is sinking so deep into soft material that he is not able to move forward, he should be forced to lie down as quickly as possible and rolled on his side.

Before he is permitted to again rise on his feet, it will be necessary to increase in some way the bearing power of the soil or distribute the weight of the horse over a larger area. This can be done by covering the soil immediately around the horse with a thick coating of hay, fine brush, or other mater-

ials which will distribute the weight. Such a covering will necessarily have to extend to the nearest solid land.

The bearing surface of the horse can be considerably increased by packing some light material around the hoofs. This may be gunny sacks or other cloth covering, or hay held in place by gunny sacks. Under ordinary conditions where a horse has mired, a combination of the two methods mentioned can be used to advantage; increasing the area of the horse's hoof by padding with a material as described, and then covering the ground in the near vicinity with some material that will prevent him from miring while he is regaining his feet.

FIG. 1. AN ORDINARY HORSE SHOE WITH CALKS PROPERLY SHAPED FOR HOLDING A BOG SHOE.

Every effort should be used by the driver, on soft ground or where there is danger of miring, to prevent the horse from becoming excited and struggling after he has begun to mire.

The fact that it has been found that a horse with his feet well padded with some soft material can walk over a soil on which he would otherwise mire, has lead to various attempts to construct a permanent padding or small platform which can be readily attached to the horse's hoof and enable him to perform work on soft soils where he could not be taken under ordinary conditions. Such a device is commonly known as a bog shoe. Bog shoes are not generally used in Minnesota except by the companies that use wire grass in the manufac-

ture of carpets and rugs, as the best quality of this grass grows on boggy lands which under ordinary conditions will not support a horse. It has become necessary for these companies to experiment with various forms of material, and various methods of attaching to the horse's hoof a set of bog shoes.

In some of the eastern states where boggy lands have been cultivated for a number of years for the growth of such crops as celery, mint, etc., every farmer owns a set of bog shoes and does not attempt to cultivate peat or muck lands without their use.

It has been found that any horse can learn to use bog shoes to a certain extent, some horses becoming much more

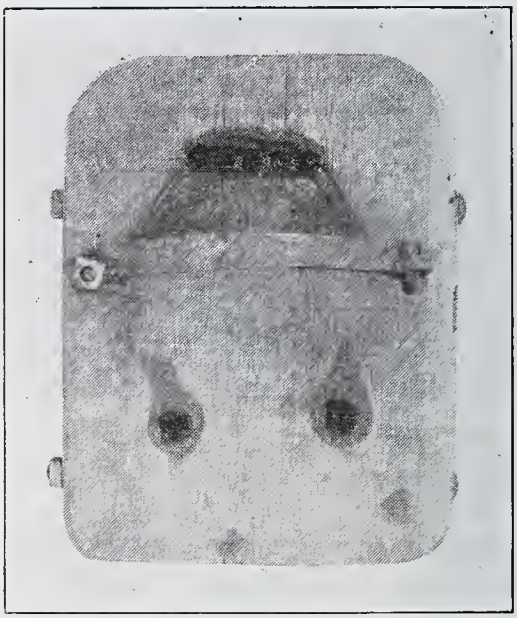

FIG. 2. STYLE OF BOG SHOE IN USE BY THE CREX CARPET COMPANY.

expert in their use than others, and it has been found that horses experienced in working such lands often refuse to approach soft land when the bog shoes are not on. At first glance at a horse wearing bog shoes one would think that the shoes would interfere and overreach, but the horse soon learns to take short steps, swing his feet well out, and while he can-

not walk as rapidly as under the ordinary conditions, he can pull a considerable load and seldom interfere or overreach.

The horse learning to wear bog shoes is liable to become excited, stumble, step on the toe of the shoe, and mire, in which event it will be necessary to get him on his side as quickly as possible, and either dig or pull away with the hands

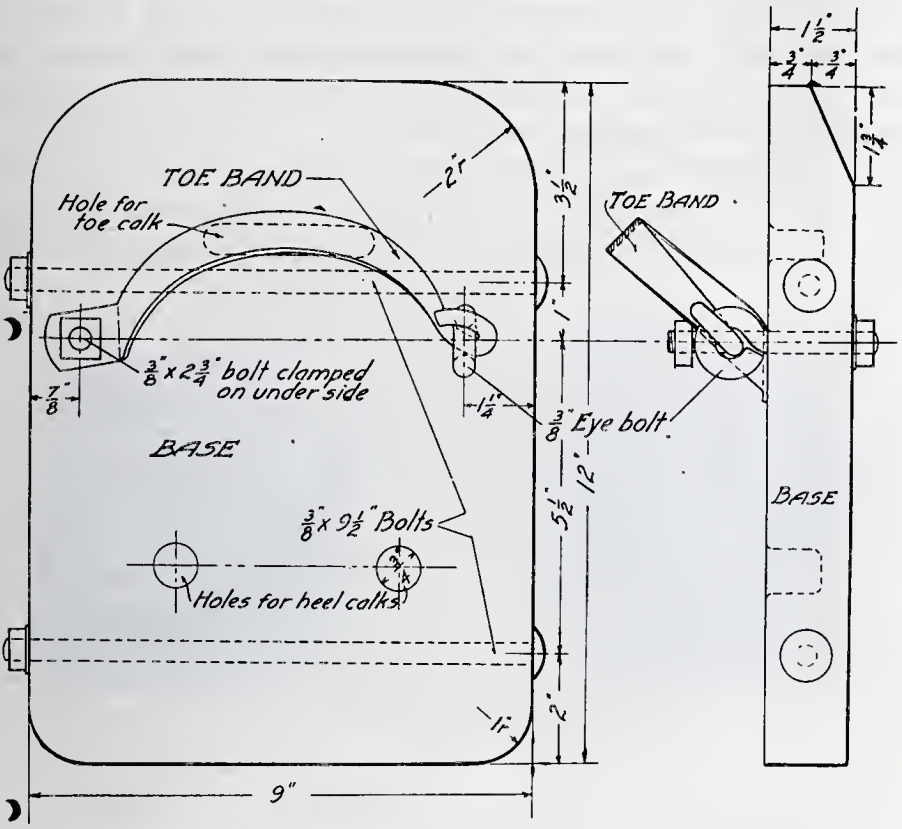

FIG. 3. DETAILED DRAWINGS OF BOG SHOE SHOWN IN FIG. 2. MINIMUM SIZE OF BASE—8" BY 9"; MAXIMUM SIZE—12" BY 14". ALL OTHER DETAILS ARE THE SAME, REGARDLESS OF THE SIZE OF THE BASE.

the material around the shoes until they can be released and the horse rolled on his side. After a little experience the horse will learn to step properly and if he does mire, will lie down and roll over. Consequently the horse learning to use bog shoes should be worked on soft ground either where he will not mire or where the soft material is very shallow, until

he has learned how to step and acquired confidence in himself, and does not become excited when he finds the bog shoes attached to his feet.

In selecting horses for work in miry bogs, the maximum size should be limited to about 1,400 pounds, but horses weighing from 1,200 to 1,300 pounds are better.

The bog shoes may be placed on the two hind feet or on all four feet, depending on the softness of the ground and the pulling powers required to move the load, and their size depending on the same conditions.

Bog shoes vary in size from 8 inches wide by 9 inches long, to 12 inches wide by 14 inches long. Due to the fact that a horse exerts more pulling power with his hind legs than with

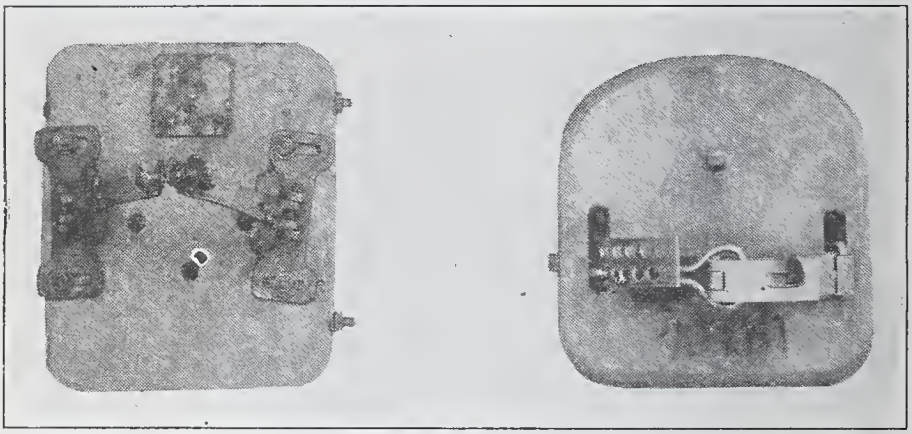

FIG. 4. KELSEY BOG SHOE CARRIED IN STOCK BY DEALERS. NOTE THE THREE HOLES BORED THROUGH THE BASE TO PREVENT SUCTION.

FIG. 5. A BOG SHOE IMPORTED FROM SWEDEN.

the fore legs, the hind shoes are often made 1 to 2 inches larger in each dimension than the front shoes. Land that is too soft to carry a horse with the largest shoes specified, will ordinarily be too soft for the operation of any kind of machinery, and this size may be considered as the limit. Where bog shoes must be used, it is advisable to use wheels with extra wide tires on the machinery.

At the present time many different styles of bog shoes

have been developed and opinions vary considerably in regard to the merits of each of these styles. An effort has been made to learn the advantages and disadvantages of each style together with the service that has been required of it. It is probable the service required of a bog shoe by the carpet and rug companies is the most severe test, and from the large number of shoes used by these companies, they have given more attention to the development of a shoe that will be satisfactory under all conditions of service.

The commercial bog shoes are practically all made of wood. Yellow birch, oak, ash, and elm have been given the prefer-

FIG. 6. BOG SHOE FREQUENTLY USED ON MULES.

ence, although there does not seem to be any particular reason for selecting one given variety over another. Any tough, strong wood that will stand the wear under local conditions will be satisfactory.

The chief difference in the various styles of bog shoes is the method of attaching them to the hoof. Due to the fact that the horse walks much slower with bog shoes than without them, it is very desirable that the method of attachment be such that the bog shoe can be quickly taken off and put on for the purpose of requiring him to wear the bog shoes only when he is actually on soft ground.

Due to the fact that the shoe settles somewhat into the wet, soft soil at each step, the air is forced out from under the shoe and when the horse attempts to lift up his foot for the next step, it requires considerable pull to loosen it. Between the settling of the shoe in the soft material and the suction powers, the fastening must be very secure or it will be pulled off. Consequently, the attachment requirement for a bog shoe is an attachment which is both rapid of adjustment and very secure when once made.

In working horses on soft ground it is very desirable to have them either barefooted or shod with smooth shoes. Consequently, many attempts have been made to perfect a bog shoe attachment that will hold the bog shoe in place on the unshod or the smooth shod hoof, but as a general statement, these attempts have turned out failures whenever any heavy service is required. In short jobs of light work, attachments have been made that are fairly satisfactory but they practically all fail under hard service.

For continuous work and hard service the horse that is to wear bog shoes must first be shod with a special shoe nailed to the hoof. This shoe should have long, heavy heel calks. See Figure 1. Each bog shoe, regardless of its pattern, is expressly fitted to a certain foot of a certain horse.

The bog shoe which apparently has given the best satisfaction is the one shown in Figure 2 used by the Crex Carpet Company. This shoe is not carried in stock by commercial dealers, but with the illustrations and descriptions given any blacksmith or mechanic should be able to make a set and properly fit them to the horse (see Fig. 3.) The base of the shoe is formed of the wood available and a size to correspond to what has previously been stated. After the horse has been shod with a shoe similar to that shown in Figure 1, the base of the bog shoe is placed up to the foot and the location of the calks of the horse shoe are marked on it. The notch for the toe calk is chiseled out and heel calks bored with a bit corresponding in size to the calks. The heel calks should fit very securely, as they are the important factor in holding on the bog shoe.

The bog shoe should be so placed that it is slightly heavier

behind than in front. It is necessary to determine this from the appearance of the horse's foot. The toe of a short, straight hoof will set farther back from the toe of the bog shoe than that of a long, spreading hoof. The holes for the calks having been made, the location of the toe band is next determined. The toe band should be so adjusted that it will bind about one-half way between the toe and the top of the hoof. This band should fit flat and even all around as it must

FIG. 7. A BOG SHOE MADE OF RUBBER BELTING. FAIRLY SATISFACTORY FOR USE ON SOD. UNLESS PROPERLY ADJUSTED IT WILL CAUSE SORE FEET.

be drawn tight. It should not be too high or it will make the foot sore.

Some recommend that three or four holes be bored in the central part of the shoe for the purpose of admitting air to relieve the suction.

To cause the base to set as conveniently as possible for the horse, the foot should set slightly nearer the inner edge. For convenience in putting on and taking off the bog shoe, the eye of the toe band is placed on the inside and the nut on the outside. After such a bog shoe has once been fitted, the only procedure necessary in putting on the shoe or taking it off is

the tightening or loosening of the nut on the outside. For this purpose a small wrench of convenient pattern should be carried.

Figure 4 shows a commercial shoe that is carried in stock by some dealers. It is known as the Kelsey bog shoe. It was originally devised as a bog shoe to fit any sized hoof, without hoof being shod. The three little spikes in front which enter at the shell of the hoof and the roughened plates on the side are to prevent the foot from slipping backward, while the toe band acts in the same manner as on any other bog shoe. It has not been found a complete success on an unshod foot. However, with a shod foot and holes in the base for the calks, this is a convenient bog shoe for light service and is quite adjustable to any ordinary hoof.

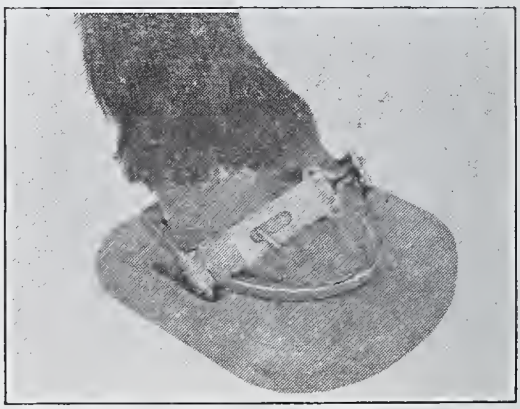

FIG. 8. BOG SHOE SHOWN IN FIGURE 5 ATTACHED TO HOOF OF HORSE.

Figure 5 is a Swedish type of bog shoe. It is 9½ by 10½ inches and 1¼ inches thick. To use these shoes the horse is first shod with smooth shoes. The large spike shown at the forward part catches the back of the shoe and prevents the foot from slipping out. With this arrangement for holding the bog shoe in place, it is better not to have calks on the horse shoes as they work around and slip by the spike. The fastening device on the toe band has not proved very satisfactory as it is impossible to get it real tight. The principle of this toe band is the same as on any other shoe but the system of adjustment as shown in the illustration is different. This

shoe with no modifications is not suitable for hard and heavy service, but will answer for light work.

It would be possible to make a fairly satisfactory shoe for a horse that is smooth shod by using the base of the shoe shown in Fig. 5, the spike as shown to be used, or a bolt with a large head or nut could be substituted in its place. Then on this base place a toe band similar to that shown in Figure 2. Such a combination of these two bog shoes would answer for a limited amount of work when it is not desirable to go to the expense of reshoeing the horse for the purpose of fitting the shoe as shown in Figure 2.

Figure 6 shows a style of bog shoe that has been used in the West by teamsters who often find bad stretches of soft ma-

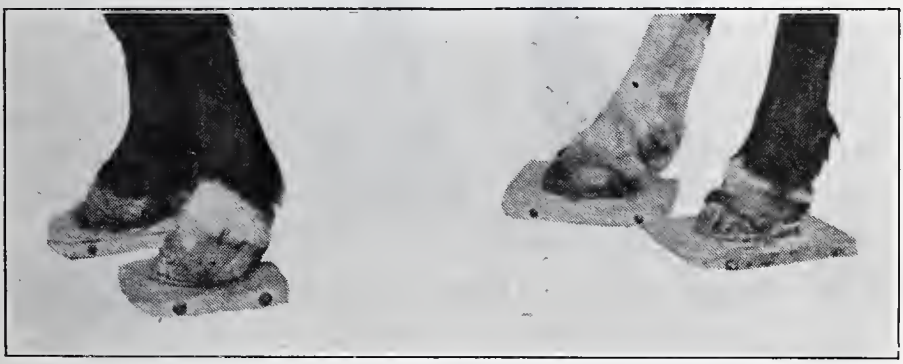

FIG. 9. SIDE VIEW OF HORSE EQUIPPED WITH FULL SET OF BOG SHOES SIMILAR TO FIGURE 2.

terial to traverse. This shoe is specially adapted to a mule's hoof, which is very straight and hard to fit with an ordinary toe band. This style of bog shoe can only be used on a hoof which has been shod with the "never-slip" screw calk shoes. Holes are bored in the wooden base to correspond to the screw calk holes in the horse shoe. The bog shoe is attached to the foot by screwing out the "never-slip" calks, placing the base in position on the shoe, and holding it in place by short machine bolts which fit into the screw calk threads. The base can be made of any size and thickness the occasion may demand. The chief merit of this shoe is its simplicity, although the method of attachment is rather slow and inconvenient. Its disadvantage is that in bad places there is much danger of

pulling off both bog shoe and horse shoe, for the only method of holding it to the hoof is the nails in the horseshoe.

Figure 7 shows a method of constructing a bog shoe for an unshod hoof. This shoe is made of quarter-inch belting, two thicknesses being used for the base, the dimensions being approximately the same as for wooden shoes. One vertical thickness of belting is placed at right angles to the base and curved around so as to fit smoothly on the hoof. Five leather

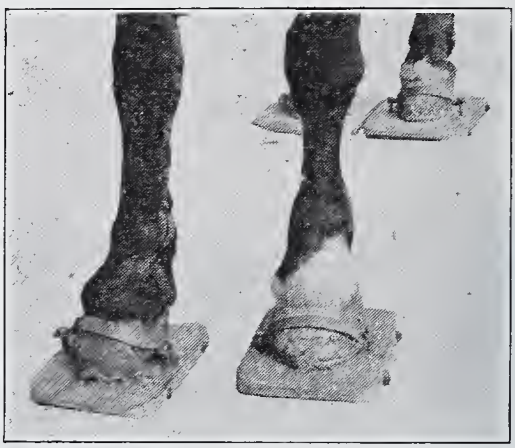

FIG. 10. FRONT VIEW OF HORSE EQUIPPED WITH FULL SET OF BOG SHOES SIMILAR TO FIGURE 2.

loops are attached to the base and extend to the top of the vertical section, the lower end of the loops and the vertical section are fastened to the base by means of quarter-inch bolts. A three-quarter-inch leather strap is run through the loops and buckled tightly around the hoof which holds the bog shoe in place.

Bog shoes of this construction are not satisfactory for heavy service as there is more or less bend and give to them. The material and the strap stretch permitting the shoe to become loose from the hoof and causing it to be easily pulled off. In case the strap is buckled too high on the hoof it will soon cause sores to come on the feet. Such shoes are frequently used on sod that is fairly solid.

HISTORY AND ORGANIZATION OF SWEDISH PEAT SOCIETY

By Hernfrid Witte, Ph. D.,
Director of the Swedish Peat Society

The Swedish Peat Society—or correctly speaking The Swedish Society for Peat Land Cultivation and Utilization—was founded in 1886 at the initiative of the late Sir Carl von Feilitzen, mining engineer and at that time director of the chemical station at Jonkoping.

The aim of the Society is:

1. To carry out at its laboratories and experimental garden at Jonkoping and at its experimental farms exactly arranged investigations and experiments regarding cultivation of peat soils;

2. To take up in its botanical and chemical laboratories all scientific investigations, that may lead to increased and enlarged knowledge of peat soils and their utilization;

3. To publish a periodical treating all questions, connected with the utilization of peat land for different purposes;

4. To give the farmers advice and information about the right utilization and the most convenient treatment of their soils;

5. To disseminate information about the utilization of peat land through lectures, lessons, pamphlets, meetings, illustration fields and through other suitable means.

From very small beginnings, the Society has gradually developed its sphere of action.

In 1886, the first number of the periodical was published, and next year pot experiments were made at Jonkoping. In 1889, a ground plot of about 5,000 square metres was purchased by the Society and an experimental garden was established there, and in 1903 an institute with laboratories was built.

In 1889, an experimental field was arranged on peat soil

in the neighborhood of Jonkoping, and one year later, the first experimental farm of the Society was founded at Flahult. In 1906, another farm of the same kind was established at Torestorp, 22 kilometres south of Jonkoping, but it was given up in 1918. Two years later, an area of about 100 hectares uncultivated peat bog was purchased at Gisselas in the province of Jamtland and a large experimental farm has here been established.

Since the start, the Society has made chemical analysis of peat soils for cultivation and for production of peat fuel and moss-litter.

In 1891 a botanist and peat geologist was taken into the service of the Society and one year earlier there was engaged an engineer for giving information to farmers; now the Society has three consulting engineers.

For the maintenance of its work, the Society receives subvention from Government, and grants from agricultural societies and county councils. The height of these grants shows to a certain extent the development of the Society. The total sum of those grants was:

1890	14,200	Sw. crowns
1900	31,500	" "
1910	48,600	" "
1920	82,600	" "
1923–24	99,900	" "

The number of members is at present about 1700.

Directors of the Society have been Carl von Feilitzen (1886-1901), Hjalmar von Feilitzen Ph. D. (1901-1920) and Hernfrid Witte, Ph. D. (1921-).

The staff of officials consists at present of 1 botanist and peat geologist, 2 chemists, 1 assistant at the experimental garden, 3 consulting engineers, 1 superintendent for the experiment farm at Gisselas, 1 manager for the experimental farm of Flahult, 1 cashier, 1 correspondent and 1 caretaker.

Presidents of the Society have been: Lieutenant-Colonel P. A., Ribbing (1886-1897) and the three Governors, Baron

Hj. Palmstierna (1898-1906), Fr. Pettersson (1907-1919) and Baron Fabian De Geer (1920-).

The work of the Society may be divided into three different branches: the practical-scientific, the consulting and the informing branch.

The practical-scientific work, aiming to increase the knowledge of peat soil, its characters and its right use for cultivation or for technical purposes, consists in field investigations on peat land, chemical analysis and different kinds of culture experiments.

The field investigations of bogs are made by the botanist of the Society and include researches of the composition of recent vegetation and the geological construction of peat bogs.

The analytical work, which is made in the chemical and botanical laboratories, intend firstly to determine by way of chemical analysis the proportions of different plant food-stuffs in peat soils, their capacity of absorbing fluids, or their fuel value, secondly to ascertain by botanic-microscopical investigations the decaying degree of the peat, its origin a. s. o. On basis of such analysis, the owners of peat land receive reports, indicating the most convenient use of the peat soil, of which they have sent samples. Until 1922, there have been made in the chemical laboratory chemical analysis of 8,058 samples of peat soil for reclamation, 3,280 samples of peat fuel and 1,762 samples of moss-litter, as well as many analyses of manure, lime, hay, grain and other products from the field experiments a. s. o. In the botanical laboratory there have until 1922 been made: 15,485 microscopical analyses of peat soil, 14,677 germination tests and other tests of seeds from the experimental farms and fields and 4,688 quantitative botanical analyses of hay.

The culture experiments, a most important branch of the work of the Society, have to take up and to investigate all questions regarding cultivation of peat soils under different climatic and other conditions. Those experiments are conducted as pot and plot tests in the experimental garden at Jonkoping and as field tests at the experimental farms of the Society, at present Flahult and Gisselas.

Local tests, illustration fields and model pastures are even arranged on private peat soils of different kinds in several parts of the country.

The consulting work, which is very extensive, is carried on by three consulting engineers, of whom each has his special district of the country. These engineers visit the farmers at request, investigate their peat bogs, and give advice and information as to the value of the bogs for reclamation and for technical purposes. In 1922, the engineers investigated a total area of 5,565 hectares of peat land, of which 4,670 hectares were suitable for reclamation or already cultivated, 515 suitable for peat fuel and 92 for moss-litter.

The informing work is carried on to make the public acquainted with the work of the Society as well as with other experiences and experiments within the sphere of peat land reclamation, peat soil cultivation and peat industry. That information is realized in the following ways:

1. By The Journal of the Peat Society ("Svenska Mosskulturforeningens Tidskrift"), which has appeared ever since 1887 with 6 numbers yearly;

2. By distributing circulars and leaflets regarding more important questions of peat reclamation, peat soil cultivation or peat industry;

3 By lectures, especially held by the consulting engineers; in 1922 the officials of the Society held about 140 lectures in different parts of the country;

4. By courses in peat land reclamation and peat soil cultivation held once a year at Flahult; those two-day courses are attended by 200-300 farmers from the whole country;

5. By meetings with lectures, discussion and excursions twice or three times yearly at different places;

6. By exhibitions at agricultural shows;

7. By illustration fields, demonstrated in summer by the consulting engineers.

NEWS OF THE INDUSTRY

Soils Adapted To Celery Growing

Celery grows naturally on low, moist, but well-drained soils, especially on the muck lands of the northeastern United States. It can be grown on almost any type of soil provided enough plant food is present and water is applied during the dry periods, but most of the successful celery-growing enterprises are located on the low-lying muck or the "hammock" soils. There are a number of different types of muck soil, but those that are underlain with marl or some form of material bearing calcium carbonate are considered best. The depth of these muck beds varies greatly, being anywhere from 18 inches to 10 or 12 feet. The adaptability of the muck to the growing of celery depends largely upon its texture and ability to supply the plants with plenty of moisture. These soils are usually high in nitrogen and deficient in both potash and phosphoric acid. If the proper physical conditions are found in the soil, the needed elements can be supplied in the form of commercial fertilizers or manure.—Farmers' Bull. 1269.

Will Investigate Peat

An investigation of the peat deposits of the country as a source of fuel has been ordered by Secretary Work. Utilizing funds from an appropriation for the study of the possibilities of lignite and peat, the secretary has ordered the Bureau of Mines to begin a peat survey, heretofore held in abeyance pending experiments by the Canadian and English governments. Investigation of lignite, however, has been under way for some time.

Writing to Senator Fletcher, Democrat, Florida, who urged surveys of the Florida peat deposits, Secretary Work declared that although reports of the British investigations had

not been received he had decided not to delay his inquiry any longer.

Massachusetts

Frank H. Foss, Fitchburg, Mass., chairman of the Republican State Committee; William M. Butler of Boston and New Bedford, Republican national committeeman from Massachusetts; Lieut. Gov. Alvan T. Fuller, Frank G. Allen, president of the State Senate and Frederick Field, treasurer of the United Fruit Company, are among those interested in a project to manufacture peat on a large scale.

An outline of the plans became known recently through the interest in them of Federal officials concerned with the fuel situation. A corporation, of which Foss will be president, will be formed to carry on its operation.

These men are understood to have applied for patents on machinery which will make the peat marketable. Those interested in the project are said to have proved to their own satisfaction the feasibility of the scheme by burning peat so made in their homes. They are confident that peat can be placed on the Massachusetts market to retail at $10 a ton with lower prices should there be a substantial demand for it. Manufacture will be started at Wrentham, Mass.

Minnesota

Cultivation by Tractors Solve Plowing Problem

Cultivation of peat lands in Minnesota through the medium of caterpillar tractors, an innovation in reclaiming these areas, has proved decidedly feasible, according to Prof. W. E. Peterson, of the Department of Agriculture, University of Minnesota, who has led a group of experimenters in this work.

The development of peat lands, also, promises to be no small matter, he said, as it has been definitely shown that properly drained, cultivated and fertilized, peat lands will

yield most abundant crops of tubers, roots and virtually all forage crops.

In explaining the features which make possible the use of the caterpillar tractor in cultivating this sort of land, Prof. Peterson pointed out that because of the looseness of the peat soil, it is almost impossible to use horses or tractors with ordinary width of wheels. In the caterpillar tractor the broader surfaced wheels enables the farmer to plow in a manner which leaves good furrows. The great power of the caterpillar tractor does a good job of making the furrow slice about 20 inches in width and ten inches in depth, something a low horse-power or light machine could not do.

Investigating Peat as Coal Substitute

The fuel shortage of the Northwest has focused attention upon the uses of peat, which occurs in quantity in Minnesota. At a recent meeting of the Minnesota section of the American Chemical Society, C. L. Walfred of the mines experimental station of the University of Minnesota and F. J. Alway presented papers on the industrial and agricultural uses of peat.

Mr. Walfred pointed out the present economic value of peat as a domestic fuel prepared either by air drying and burning in the ordinary grate stoves, or by drying, grinding and briquetting with some suitable binder. With the present shortage of fuel in the Northwest, the latter method of treatment seems the preferable, since it allows of easy transportation. Its use in small power installation is restricted to districts having large areas of peat. In these installations it is either burned in step grates or else destructively distilled in producers; a gas having a heating value of 120 to 140 B. t. u. per cubic foot being produced, which can be satisfactorily used in gas engines. Mr. Walfred showed how peat might very satisfactorily be used as a heat insulator and then reported on some work done at the mine experiment station this fall on the utilization of peat for fuel in the manufacture of pig iron.

State Officials Make Tour of Territory

Continuance of the peat station at Fens, Minn., as an experimental farm, was the object of a special tour over the Meadowlands territory recently by Ray P. Chase, state auditor; Dean W. C. Coffey of the state agricultural school and a group of prominent Duluthians.

L. B. Arnold, land commissioner for the Duluth & Iron Range railroad, was in charge of the tour. About twenty made up the party.

Visits were made at Fens, Kelsey and Meadowlands, where the peat country was examined and a study made of the conditions throughout this district. The delegation had lunch at Meadowlands at noon.

Returning to Duluth late in the afternoon, Mr. Chase and Dean Coffey were guests of the Chamber of Commerce at a dinner and meeting in the evening. A number of prominent Duluthians were invited to the dinner, which was followed by an open discussion on the peat situation in this section of the state.

James H. Harper, president of the Chamber of Commerce, issued the following statement:

"There is no one thing in which the business men of Duluth should be more interested than developing the agricultural resources of St. Louis county and particularly that part that gives itself so readily to the growing of lettuce, celery and cauliflower in large quantities."

NEWS OF THE SOCIETY

Report of the Secretary-Treasurer

SUMMARY FOR YEAR ENDING JUNE 30, 1923

RECEIPTS

Cash on hand July 1, 1922	$ 147.63
Subscriptions from members,	625.28
Journals sold	71.25
	$ 844.16
Deficit	252.70
	$1,096.86

DISBURSEMENTS

Printing and Mailing Journals	
April 19, 1922 Journal	$ 115.99
July 19, 1922 Journal	150.09
October 19, 1922 Journal	140.00
	$ 406.08
Editor's expenses	493.92
Annual meeting expenses	61.32
Clippings	31.26
Stationery	22.32
Postage	.76
Typewriting	5.00
Refund of over-subscription	2.50
Interest	19.40
Bank collection charges	.50
Express charges	3.80
Cash paid on account acceptance due April 30	50.00
	$1,096.86

STATEMENT OF FINANCIAL CONDITION

BILLS RECEIVABLE

Unpaid subscriptions	$265.00
Back numbers sold, unpaid	3.00
Cash on hand June 30, 1923	51.00
	$319.00

BILLS PAYABLE

Balance of 4th quarterly payment ($300.) due Editor under the arrangement whereby he defrays cost of publishing journal. Paid by renewed acceptance due July 30, 1923, with interest	$253.70
Surplus	65.30
	$319.00

CHAS. KNAP,

Secretary-Treasurer.

Price Of Back Numbers Reduced

An opportunity is extended to members to complete their sets of back numbers of the Journal of the American Peat Society at a price of 50 cents for each copy. This is 30 per cent of the cost of printing. The offer is for a limited length of time and only a relatively small number of copies is available. Send orders to Charles Knap, Secretary-Treasurer, American Peat Society, 2 Rector Street, New York, N. Y.

New Members

The following new members have been enrolled by the secretary since the July journal was published.

C. A. Willmarth Co., Tecumseh, Mich.

Mr. P. A. Vans Agnew, Winter Park, Fla.

Discussion by Mr. J. H. Van Glahn

I wish to call attention to my article "Short system of Producing Peat Products." published in the July Journal of The American Peat Society. The following statement was inserted in my article without my knowledge. "Mr. E. V. Moore, fuel engineer and contributing assistant editor, states that according to information which has been collected by the Peat Committee of the Canadian Government and their experience, Mr. Van Glahn's claims for his drainage vats can not be realized in any sense." Mr. Moore's experience goes to show that instead of reducing the water contents to 25 per cent in one hour it would probably take two or three months if peat were spread 26 inches deep.

I wish it understood that by my short system of producing peat the drainage vats without the mechanically operated roller would be of very little use for reducing the water contents from peat, nor would the mechanically operated roller be of any consequence without the drainage vats. Therefore these two devices, the so called drainage vat and mechanically operated roller, are combined into one machine and operated as one machine constituting my peat water extractor which by experimental test has proven a complete success.

The peat water extractor is designed on strictly true mechanical lines, simple of construction, is under immediate control by the operator, revolves from one to ten times per minute as desired, requires less than fifteen horse power and can be operated by a common laborer with ease and precision. Either gasoline or electric power can be used to suit conditions.

The mechanically operated roller is made to revolve both ways, backward and forward and travels the entire length of a drainage vat in less than one minute time. At the end of a vat the roller is lowered as desired and reversed to travel back to the other end of the vat. These operations are repeated until the roller has passed over the product from forty-eight to fifty times in one hour in which time the water content is reduced to 25 or 30 per cent according to the nature of the peat used.

The water content by the short system of production is extracted by means of vibration and pressure. The drainage vats are scientifically constructed to release and expel the water content immediately as the roller is applied to the product. The roller for a 146 ft. drainage vat is 9 ft. in diameter and revolves about 5½ times in a minute, traveling the length of a drainage vat in less than one minute. Each time the roller passes over the product from one end of a vat to the other is termed one operation.

The following data were compiled from one of several tests made with my peat water extractor:

1. Eight operations condensed peat from 26 inches in depth to 15 inches in depth.
Reduced the water content from 87 per cent to 62 per cent.

2. Eight operations condensed peat from 15 inches in depth to 11 inches in depth.
Reduced the water content from 62 to 48 per cent.

3. Eight operations condensed peat from 11 inches in depth to 9 inches in depth.
Reduced the water content from 48 per cent to 39 per cent.

4. Eight operations condensed peat from 9 inches in depth to 8½ inches in depth.
Reduced the water content from 39 per cent to 33 per cent.

5. Eight operations condensed peat from 8½ inches in depth to 8 inches in depth.
Reduced the water content from 33 per cent to 30 per cent.

6. Eight operations condensed peat from 8 inches in depth to 7¾ inches in depth.
Reduced the water content from 30 per cent. to 28 per cent.

The above test is typical of several others made with a crudely constructed drainage vat in principle the same as described in my article "short system of Producing Peat", and a wooden roller operated without mechanical appliances to obtain pressure.

The roller was operated over the peat contents 48 times and the water content was reduced from 87 per cent to 28 per cent.

I wish to state that I do not hold the American Peat Society responsible for any of my statements. I have had thirty years of practical experience in designing machines and erecting manufacturing plants of various descriptions enabling me to develop reliable mechanical devices.

ADVERTISEMENTS

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Thos. F. Manns, Plant Pathologist and Soil Bacteriologist, University of Delaware, Newark, Delaware.

Address communications for committee to J. H. Beattie, McLean, Virginia.

SCOPE AND PURPOSE OF SOCIETY

The American Peat Society was organized at the national exposition at Jamestown, Va., on October 23, 1907, and was incorporated in 1912. It is an organization devoted to research and to the dissemination of information concerning the origin, metamorphosis, geographic distribution, physical and chemical properties, and uses of peat and muck.

Through its Advisory and Research Committee, consisting of botanists, geologists, chemists, bacteriologists, and engineers of recognized standing, the society will answer inquiries from members relating to the use of their deposits. There is no charge for general service.

NATURE AND USES OF PEAT AND MUCK

Peat and muck are residues resulting from the arrested decomposition of leaves, twigs, roots, trunks of trees, shrubs, mosses, and other vegetation in areas covered or saturated with water. They may be identified as the dark-colored soils found in bogs and swamps and in other low places. The commercial uses of peat and muck are varied. In the United States they are utilized chiefly as crop soils, as soil conditioners, and as ingredients of fertilizers. In some of the countries of Europe peat is used for fuel and is the basis for small manufacturing industries. Gas, charcoal, coke, and some by-products are produced in small quantities. Peat moss, marsh grass, and fibrous peat are employed in the manufacture of litter, packing material and rugs, and selected varieties of peat moss have been used to make surgical dressings.

ECONOMIC ASPECTS OF PEAT

The United States contains over 12,000 square miles of undrained peat and muck land. The average deposit, if used for industrial purposes, will yield 200 tons per acre-foot. It is estimated that the deposits would be capable of yielding about 14 billion short tons of air-dried peat. Peat and muck areas are distributed throughout the Great Lake, Pacific Coast, and Atlantic Coast States. Peat and muck in Canada cover 37,000 square miles. According to published statistics, European countries annually consume about 50 million tons of peat fuel.

MEMBERSHIP

Present membership of the American Peat Society consists largely of agriculturists, engineers, and peat and muck land owners and producers. Persons interested in agriculture, in soil fertilization, in the chemical and bacteriological aspects of vegetable matter, and in the production of fuel or generation of power, may join. Applications should be addressed to the secretary. Membership and subscription to the Journal cost $5.00 a year.

CONVENTIONS AND PUBLICATIONS

Meetings of the Society are held annually in important cities throughout the peat regions. Papers are presented relating to the subjects enumerated. A quarterly journal, containing the proceedings of the Society, papers concerning all phases of peat, muck, and allied subjects and news of the industry, is published and sent to members. The scope of the papers is very broad, including the location of deposits, drainage and reclamation problems, methods of cultivation, fertilizer requirements, crop adaptation, cultural practice, physical and chemical characteristics, engineering practice, and production methods. One of the principal objects of the Society is the exposition of extravagant claims made by promoters.

APPLICATION FOR MEMBERSHIP

IN THE

American Peat Society.

_____

(Date)

MR. CHARLES KNAP, *Secretary-Treasurer,*
American Peat Society,
2 Rector St.,
New York, N. Y.

Dear Mr. Knap:

Application is hereby made for membership in the American Peat Society. Check in the sum of $5.00 for subscription to the Journal of the American Peat Society during the first year is inclosed. It is understood that the payment of this sum will admit me to the society and entitle me to all the privileges granted to members by the constitution. This action is prompted by my interest in the science and utilization of peat and muck and the welfare of the society.

Yours very truly,

_____

(Signature)

_____

(Address)

PAST PRESIDENTS OF THE AMERICAN PEAT SOCIETY

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State Geologist of North Carolina,
Chapel Hill, N. C.

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Manuscripts sent for consideration by the editor should be registered. Written discussions of papers are invited. Authors wishing reprints of articles are requested to correspond with the editor. Advertising rates will be furnished upon application to the secretary.

Price List of Back Numbers of the Journal of the American Peat Society

A special price of 50c each for back numbers has been temporarily made to members.

		Members	Non-members
Volume	1—Complete	$4.00	$4.50
	No. 1	1.10	1.25
	No. 2	1.10	1.25
	No. 3	1.10	1.25
	No. 4	1.10	1.25
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	No. 2	2.20	2.50
	No. 3	1.10	1.25
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Volume	3—Complete	4.00	4.50
	No. 1	1.50	1.80
	No. 2	1.50	1.80
	Nos. 3 and 4	1.50	1.80
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	No. 2	1.50	1.80
	Nos. 3 and 4	1.50	1.80
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	No. 3	1.10	1.25
	No. 4	1.10	1.25
	No. 5	1.10	1.25

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	No. 3	1.10	1.25
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Volume	10—Complete	5.00	6.00
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	No. 2	1.25	1.50
	No. 3	1.25	1.50
	No. 4	1.25	1.50
Volume	11—Complete	10.00	12.00
	No. 1	2.50	3.00
	No. 3	1.25	1.50
	No. 4	1.25	1.50
Volume	12—Complete	5.00	6.00
	No. 1	1.25	1.50
	No. 2	1.25	1.50
	No. 3	1.25	1.50
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	No. 2	1.25	1.50
	No. 3	1.25	1.50
	No. 4	1.25	1.50
Volume	15—Complete	5.00	6.00
	No. 1	1.25	1.50
	No. 2	1.25	1.50
	No. 3	1.25	1.50
	No. 4	1.25	1.50
Volume	16—Complete	5.00	6.00
	No. 1	1.25	1.50
	No. 2	1.25	1.50
	No. 3	1.25	1.50
	No. 4	1.25	1.50
Volume	17—		
	No. 1	1.25	1.50

This list supersedes all previous prices.

Send orders to Chas. Knap, Secretary, American Peat Society, 2 Rector St., New York, N. Y.

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The American Peat Society through its newly organized Advisory and Research Committee, c o n s i s t i n g of scientists of standing, will answer inquiries from members relating to the use of their deposits. There is no charge for general service. Address J. H. Beattie, Acting Chairman, McLean, Virginia.

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